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OCTOBER 1985

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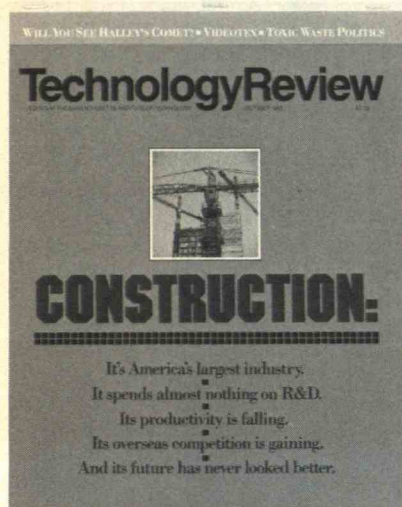
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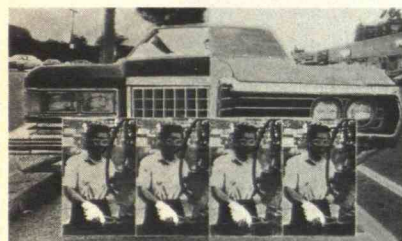
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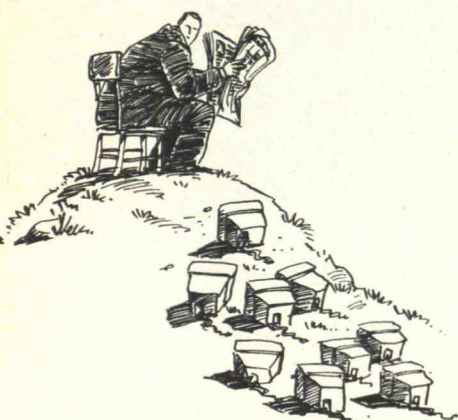
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Neither Left nor Right

In "Charting the Way the World Works" (*February/March*, page 54), Donella Meadows—perhaps attempting to preclude criticism of global models—assures us that they "are not meant to predict." A major portion of her article is then devoted to predictions such as "present policies will lead to an increasing gap between rich and poor." If the models are not meant to predict, whence her predictions, and why? The article's leftwing slant cries out for correction.



Scientific investigation through various means, including models, can be useful in gaining knowledge and testing theories. However, long-range forecasts should be given little credence. It is not possible to foresee the scientific and engineering achievements to come. Who would have foreseen the transistor 50 years ago? Even short-range doomsayers have been wrong about energy availability. The free market and free scientific exploration should be allowed to develop answers to our needs. Government intervention will generally impede rather than help.

George E. Williams
Naples, Fla.

The author responds:

One characteristic of social-system computer models is that they require such rigorous, consistent statements of assumptions and such attention to real data that they never uphold strong ideologies. The global models ruthlessly ex-

pose the ways in which both the "left" and the "right" are each partially right and partially wrong. Therefore, they are continually attacked by both the left and the right.

Unfortunately for our beliefs, the models suggest that neither pure centralized planning nor pure free markets produce stable or desirable systems. Each form of organization has its strengths and weaknesses. There is no government in the world that is a pure example of either. While our rhetoric at the moment is pushing those on the left and the right farther apart, our pragmatic experience is bringing our actual social system closer together. We will have a chance for peace when we start paying attention to our experience instead of our beliefs.

Embryo's Rights: A Matter of Awareness

Peter Singer's "Does an Embryo Have Rights" (*February/March*, page 27) reveals the fuzziness of his ideas about when human life begins. I would suggest a simple criterion. The sperm and egg cells are haploid, in that they have only 23 chromosomes—half the number in most normal body cells. When the sperm and egg join to become diploid, with the full complement of 46 chromosomes, they can be considered truly human. I have not seen the diploid-versus-haploid dichotomy used in arguments over rights of the unborn. Singer's statement that "an egg and a drop of seminal fluid, viewed collectively . . . have the potential to develop into a mature human being" is silly.

John M. Hunt
Houston, Tex.

Such phrases as "religious taboos," "religious doctrine apart," and "a discussion free of . . . doctrinaire religious teachings" indicate that Singer undertakes his quest for moral guidelines without reference to religious beliefs. Religion is a vital source of moral standards which should not be discredited.

There was a time when religious authorities rejected scientific principles that they felt might interfere with their control over "truth." Let us hope that the scientific community does not forget this dangerous precedent and adopt the same policy with respect to religion.

Gary Johnson
Garland, Tex.

The author replies:

There are two separate issues involved in John Hunt's letter: when a being has intrinsic value of its own, such that it is wrong to kill it, and when there is a potential for human life. On the first issue, technical details about cell structure do not make a difference. If we discovered that the same cell structure exists in humans and, for example, some species of mollusc, we would not think that killing a member of that species would be like killing a human being. Obviously, the level of the organism's consciousness or awareness—not the structure of the cell—is relevant here.

On the second issue, it may be unusual to regard sperm and egg, when viewed collectively, as having the same potential as the early embryo. But I cannot see that there is anything silly about this. The difference is, at most, a matter of degree. There is much greater difference between the early embryo and the mature human

being than between the embryo and the sperm and egg.

Gary Johnson correctly detects that I do not believe religious doctrines should influence the discussion of moral issues in a pluralist society. Why should laws made in accordance with a particular religious view affect the lives of people who do not subscribe to that religion? It is the height of arrogance to assume that one's own religious views are correct and should rule others.

The Future of NASA

William Lasser's article on NASA's future (*"The Manned Space Station: NASA's Last Hurrah?"* February/March, page 12) is based on the fallacy that the business of NASA is business.

NASA was established in 1958 as an R&D agency and a follow-on to the old National Advisory Council for Aeronautics (NACA). By conducting the research that was too expensive for fledgling aviation companies at that time, NACA played a major role in getting the U.S. aviation industry off the ground.

Today NASA provides the same basic function for private industries trying to become established in space. NASA is therefore not in the business of running the space shuttle fleet or, in the coming decade, the space station. The transfer of these assets from NASA to the private sector will not result in NASA's termination, as Mr. Lasser implies. There will always be R&D work to be done, and I am confident that NASA will be doing its part for a long time to come.

Thomas J. Frieling
Bainbridge, Ga.

Mr. Frieling is executive director of the Campaign for Space political action committee.

Mr. Lasser speaks of NASA as if it existed merely to entertain us on television. The interest expressed by the world audience as well as Americans is much more profound than simple amusement over NASA's "big events." History will place NASA high on the list of humanity's greatest achievements.

I have only one misgiving. NASA has tied itself too closely to the Department of Defense. This has alienated European interest in joint projects. NASA should become more independent and join the

*Editors' note:*

In "Little Slips and Big Disasters" (July, page 77) we made an editorial slip which we hope will not result in any disaster. When we said that "Nolan was distracted by thoughts about the gift," we meant to refer to Motorman Newson, not Captain Nolan.

European space agency in developing a large space-station complex for purely scientific research. The Defense Department can build its own space platform with NASA's advice. NASA's credibility as a civilian space agency should remain intact.

Pete R. Miller
Redmond, Wash.

William Lasser brands President Reagan's call for creating a manned space station "within a decade" a political failure. I find this a strange conclusion to draw when tens of thousands of letters voicing support for the program poured into the White House and NASA even before the State of the Union address. The Europeans and the Japanese are preparing to add their own funds to the project. In addition, many commercial entities here and abroad have expressed interest in using the station even before a single piece of hardware has been built.

Continued on page 21

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Silent partners in world health

Schistosomiasis affects as many as 200 million people in Africa, Asia, the Middle East, Puerto Rico and Latin America. It is often called "snail fever" because at one stage of their life cycle, *Schistosoma* worms infect snails that live on the bottom of rivers and streams. These parasites invade the skin of humans who drink, wash or swim in contaminated waters. They can cause severe itching, fever, diarrhea, and eventually irreversible damage to the liver. For 16 years, researchers visiting the island of St. Lucia in the Caribbean have been testing the practicality of various methods of control. Three approaches have proven to be most effective.

First, a public health team sprayed the rivers and streams of St. Lucia to get rid of infested snails. New plumbing facilities were constructed to assure a supply of uncontaminated water. Finally, treatment of people carrying the parasite was greatly facilitated by a drug developed and supplied by Pfizer. While previous treatments had to be given by injection, this drug was given orally only once, making it much simpler to reach a large number of people. The total control and elimination of the parasite is not yet a reality, but this combined medical and environmental program has done much to make life better for the people of the island.

Developing a drug such as this is a significant task that takes a decade or more and tens of millions of dollars. It generally involves the synthesis of hundreds of compounds in the organic chemistry laboratory. These compounds are then screened for antiparasitic activity. If one or more of them shows promise, the next step is to do toxicity studies and learn all about how the potential new drugs behave in laboratory animals. Only after completion of extensive, time-consuming animal studies can the drug be tested for safety and effectiveness in humans. And clinical trials in human patients can last for several years. If the clinical trials indicate that the drug should be made

available, new technology must be developed to produce it on a mass basis, and in cases like this, with little if any profitability for the developer.

Drug research and development isn't always "good theater." And it's largely a team endeavor generally without charismatic heroes. The days of Paul Ehrlich and his "magic bullet" are long past. The work of the pharmaceutical industry isn't usually the stuff of TV documentaries. More often, the industry has been the silent partner of government agencies, physicians, nurses and their associates working together to improve public health in St. Lucia and other developing countries.

In the Third World, pharmaceuticals are perhaps even more important than in advanced industrial countries. Often they are the only form of advanced medical technology which is practicable. Other forms of care, such as surgery, are often too cumbersome and too demanding of scarce resources. Drugs, by comparison, are portable, relatively inexpensive and comparatively simple to use.

The vast majority of drugs for the Third World and also for developed countries originate in the pharmaceutical industry. The government agencies do not have the broad expertise or resources for drug development, and medical schools and universities have different missions. Only the major research/pharmaceutical companies have the necessary skills and resources. Most manufacturers of generic drugs lack the research capabilities to create new drugs and test them for safety and efficacy. And that's only one reason an economically viable research-based pharmaceutical industry is important to all of us.

Pfizer is pleased to have been a partner in helping to reduce the hazards of one of the world's more widespread health problems. Pfizer is also pleased to be working on other solutions to similar health problems around the world.



PHARMACEUTICALS • A PARTNER IN HEALTHCARE

Togetherness in Space

CARL Sagan has a dream. Some time in the not too distant future a spaceship will head to Mars served by a Soviet-American crew. Once the ship is far from earthly help, the Americans will depend on the efficient, intelligent work of their Soviet colleagues for their own well-being, and the cosmonauts' success and survival will depend on that of the American astronauts.

Is that situation so different from the present nuclear standoff in which the superpowers are hostages to each other? Sagan asks. He suggests that, in meeting the challenges of such a Mars expedition, the two nations might learn lessons valuable here on Earth.

Given today's frosty U.S.-Soviet relations, that fantasy may seem more like an impossible dream than a viable long-term goal. Nevertheless, there is a cautiously hopeful sense within the American space community and Congress that the time may be right for greater Soviet-American cooperation in space.

For one thing, President Reagan committed himself to seek such renewed cooperation a year ago when he signed a congressional joint resolution to that effect. Also, in the spirit of the resolution, James Beggs, NASA administrator, has said that his agency is actively trying to set up joint projects where feasible. Thus, although the Soviets initially turned down an invitation this year to carry out a shuttle-Salyut space-station rescue exercise, the subject of cooperation is expected to be on the agenda of November's U.S.-Soviet conference in Geneva.

Then, too, there seems to be a fairly widespread wish that the United States and the Soviet Union should contain their hostilities and find more areas, such as manned spaceflight, in which they can work together. Certainly Sagan had a point when, speaking as president of the Planetary Society, he told the conference on human exploration of Mars in July that many people "wish the major technological nations on the planet would do something together on behalf of all mankind."

The American Institute of Aeronautics



*Can
scientific need overcome
political constraints to spur
U.S.-Soviet cooperation
in space?*

and Astronautics joined with the Planetary Society in sponsoring the Mars symposium. It marked the tenth anniversary, on July 17, of the Apollo-Soyuz mission, in which U.S. astronauts and Soviet cosmonauts linked up their spacecraft in Earth orbit. The symposium provided a natural forum for discussing how realistic the hope for space togetherness may be.

A useful degree of cooperation beyond the Apollo-Soyuz mission has already occurred. In 1972, the unmanned Soviet Lunokhod craft ran around on the moon using U.S. maps. Soviet-supplied data helped U.S. scientists to design the parachutes used by Viking Mars landers in 1976. NASA is helping the Russians track their Vega probes now heading for Halley's comet.

Joint projects give the U.S. a window into the Soviet space program that it would otherwise lack. But they have pitfalls, as the congressional Office of Technology Assessment (OTA) detailed in a study also released in July. Neither nation wants to give away militarily sensitive technology. And neither wants to be left

holding the bag if the other unilaterally cancels a joint venture.

The toughest question to answer concerns the foreign-policy goals of the joint space projects. The projects seem less a means of reducing tension than a reflection of U.S.-Soviet relations generally. The 1972 treaty that made the Apollo-Soyuz mission possible stemmed from the general atmosphere of détente; it did not help generate that cooperative atmosphere. President Reagan let the treaty expire in 1982 to show displeasure at Soviet actions generally, and not because of specific problems with space projects. Formal cooperation in space can be renewed only in the larger context of mutual U.S.-Soviet accommodation: Hence the hope that the U.S. space community has placed in the November summit.

Meanwhile, Rep. Bill Nelson (D-Fla.) and Sen. Spark Matsunaga (D-Hawaii) suggest that U.S.-Soviet cooperation could and should be part of a larger multinational partnership. They have introduced companion resolutions that, if passed, would have the United States invite the world to join in an International Space Year (ISY) of intensive research. This would do for the solar system what the old International Geophysical Year (IGY) did in developing a massive new scientific understanding of Earth. The ISY would start in 1992 and actually run for several years. The resolution's sponsors note that 1992 is a happy confluence of anniversaries. It will be 500 years after Columbus's discovery of America, 75 years after the Russian Revolution, and 35 years since the IGY, which opened the space age.

Such a project should be feasible. It is no more technically ambitious than the original IGY was in its day. Many nations could play useful roles. And the program probably would provide a diplomatic context for U.S.-Soviet space cooperation and leadership of projects.

But first, those two nations need to improve their direct relations. There may be some truth in the oft-repeated assertion that working together on the space frontier can help the two superpowers learn to coexist more happily on Earth. But it is most certainly true that a better working relationship must first be established on Earth if a sustained joint effort in space is to leave the launch pad. If this relationship can be established, Carl Sagan's joint mission to Mars may not be such an impossible dream. □



ROBERT C. COWEN IS
SCIENCE EDITOR OF
THE CHRISTIAN SCIENCE
MONITOR AND FORMER
PRESIDENT OF THE NA-
TIONAL ASSOCIATION
OF SCIENCE WRITERS.

An electronics unit that took six years to complete will operate for 12 seconds when it plunges into the skies of Jupiter this decade. The device, called a pyro control unit, is a key element of the Galileo probe that will be launched in 1986. Armed with seven scientific instruments, the probe will penetrate the atmosphere of Jupiter and, in less than an hour, collect data that will feed scientific thought on planetary evolution for years to come. Tiny explosive bolts in the pyro control unit will fire at three intervals to deploy a small parachute, blow away the probe's aft heat shield (in turn triggering the opening of the probe's main chute), and extend the forward heat shield. The unit also will turn on an instrument for measuring the size and distribution of cloud particles. The circuitry of the unit has been built to withstand forces 10 times the pressure and 350 times the gravitational pull of Earth. Hughes Aircraft Company built the Galileo probe under contract to NASA.

Efficient ways to assemble and test the Amraam missile have arisen from having manufacturing test engineers work closely with design engineers ever since the early stages of the missile development. The two groups teamed to develop common test specifications, test equipment, and testing techniques. Their efforts are expected to drastically reduce test correlation problems and to allow the missile to be produced immediately at a high rate. Hughes designed and developed the advanced medium-range air-to-air missile for the U.S. Air Force and Navy. It is in full-scale engineering development.

A state-of-the-art cable TV system will soon be carrying programs to customers in Milwaukee. The system, ordered by Warner Amex Cable Communications, Inc. (WAVE Cable), will help cut operating costs and improve the quality of service. It calls for a Hughes AML multichannel local signal distribution system, including AML-STX-141 high-power transmitters, plus receive site and upstream equipment. The system initially will provide TV programming to three hub sites, where microwave signals will be downconverted to VHF. It will incorporate long-life klystrons, automatic receiver redundancy, 450-MHz receivers with low-noise amplifiers, solid-state upstream transmitters, and a microwave line extender. At least one channel will use Hughes FM microwave equipment. The company also has AML systems in Dallas, Cincinnati, Houston, and Medford, Massachusetts.

A new generation of powerful, ultrafast semiconductor microchips can soon be produced at rates required for commercial manufacturing, using the world's most sophisticated electron beam lithography system. The system is capable of writing circuit patterns with features as small as 0.5 micrometers — about 1/200th the diameter of a human hair. It was accepted recently by the U.S. Department of Defense for its VHSIC (very high speed integrated circuit) program. The acceptance culminates four years of development by Hughes Research Laboratories and Perkin Elmer Corporation leading to the direct-write system.

Hughes needs engineers, scientists, and programmers to forge new frontiers in aerospace radars, weapon control systems and avionics, airborne displays, aerovehicle data links, and airborne countermeasures. Current openings are for people experienced in design, development, test and manufacture for systems engineering, project/program management, design of circuits and mechanisms, and bringing these to reality through the application of advanced manufacturing techniques. Send your resume to Hughes Radar Systems Group, Engineering Employment, Dept. S3, P.O. Box 92426, Los Angeles, CA 90009. Equal opportunity employer. U.S. citizenship required.



THE SKY WAS THE LIMIT.

AT&T has shattered the information barrier — with a beam of light.

Recently, AT&T Bell Laboratories set the world record for transmission capacity of a lightwave communications system — 20 billion pulses of light per second. The equivalent of 300,000 conversations, sent 42 miles, on a hair-thin fiber of super-transparent glass. But that's really getting ahead of the story.

Actually, the 20-gigabit record is only one of a series of AT&T achievements in the technology of lightwave communications.

But what does that record mean?

The Light Solution To A Heavy Problem

All of us face a major problem in this Information Age: too much data and too little information. The 20-gigabit lightwave record means AT&T is helping to solve the problem.

For data to become useful information, it must first be quickly, accurately and securely moved to a data transformer — a computer, for instance. Getting there, however, hasn't always been half the fun.

Metallic pathways have a limited transmission speed, sensitivity to electrical interference and potential for interception — factors that reduce the effectiveness of today's powerful computers. Factors that are eliminated by lightwave communications technology.

Ten Goes Into One 20 Billion Times

Three primary components make up any lightwave communications system. On the transmitting end, a laser or light-emitting diode; on the receiving end, a highly sensitive photodetector; and in the middle, super-transparent glass fibers we call lightguides.

Installing these fibers is a major cost of a lightwave communications

system. So, once installed they should stay put — increased capacity should come from fibers carrying more, rather than from more fibers.

Which brings us to the 20-billion bit-per-second story — about experimental technology that has the potential to upgrade installed fiber to meet any foreseeable capacity needs.

Using new, sophisticated lightwave system components, we multiplexed (combined) the outputs from 10 slightly different colored 2-billion bit-per-second laser beams into a single 20-billion bit-per-second data stream.

Playing Both Ends Against The Middle

But, let's start at the beginning — the 10 distributed feedback laser transmitters.

These powerful semiconductor lasers can be grown to produce light of different, but very precise, wavelengths. The lasers we used transmitted in the 1.55 micron (infrared) range, with only minuscule fractions of a micron between their wavelengths. The purity and stability of the beams let us pack their ten colors into the most efficient transmitting region of our single-mode, silica-core fiber.

To make the original 10 beams into one, a fiber from each laser was fed into a new lightwave multiplexer — a prism-like grating that exactly aimed each beam into the single transmission fiber. Over 42 miles later, a second grating fanned the beam back into its



20-gigabit
multiplexer

original 10 colors for delivery to 10 exceptionally sensitive avalanche photodetectors — receivers that convert the light pulses back into electrical signals and amplify them many times.

A similar avalanche photodetector

was the receiver when AT&T Bell Laboratories set the world record for unboosted lightwave transmission — 125 miles at 420 million bits per second.

From Sea To Shining Sea

System capacity is important. But system reliability is vital. Especially when the system is going under 10 thousand miles of water — and is expected to last for 25 years.

AT&T is going to build the first lightwave communications system under the Atlantic Ocean. A similar system is planned for the Pacific. In 1988, laser beams traveling through two pairs of glass fibers will carry the equivalent of 37,800 simultaneous conversations overseas, underwater, from the U.S. to Europe and the Far East.

AT&T has manufactured and installed lightwave systems — as large as the 780-mile Northeast Corridor and as small as single-office local area networks — containing enough fiber to stretch to the moon and back. And the capacity of each network is tailored to meet the unique needs of its users.

Systems being installed in 1985 will be able to grow from 6,000 up to 24,000 simultaneous conversations on a single pair of fibers.

AT&T is meeting today's needs with lightwave systems that are growable, flexible and ultra-reliable. And anticipating tomorrow's needs with a whole spectrum of leading-edge lightwave communications technologies.

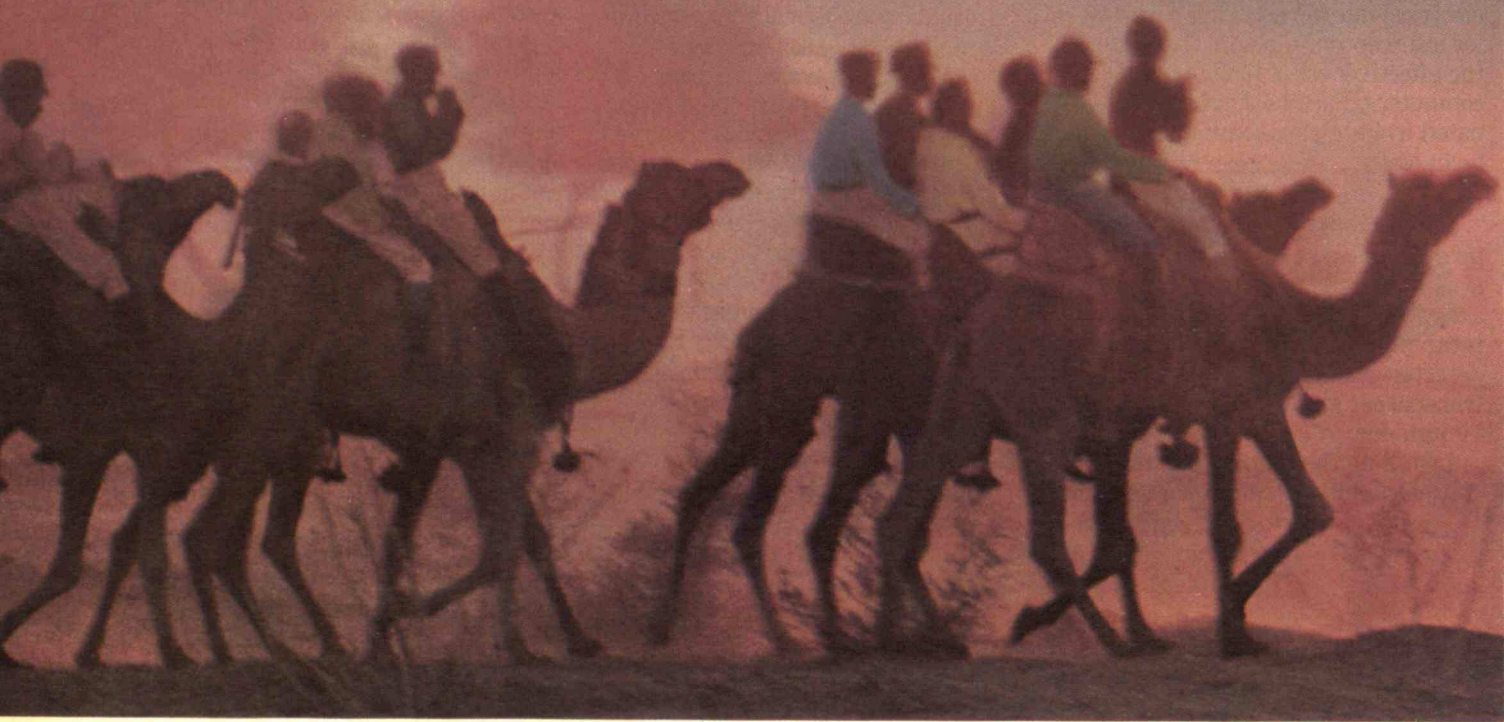


AT&T

The right choice.

"Some people still don't know KLM flies to
more cities in the Middle East
and Africa than all U.S. airlines, combined."

"Pity."



Why turn a business trip into an odyssey? Fly KLM to Europe's #1 airport in Amsterdam, and, without changing airlines or airports, on to 30 cities in the Middle East and Africa. And do it in a style that has earned KLM "best in passenger service" among all the airlines of the world. To get to the city you want to be in, not some city nearby, call your travel agent, or KLM.

The Reliable Airline of the World.



Why the Two-Car Family Didn't Buy a Third

IN the last decade American consumers have abruptly transformed their lifestyles and patterns of consumption. We are spending more money on medical care, services, and travel, and less on certain types of goods. Today, for instance, we not only buy cars that are smaller and lighter, but we are no longer expanding the number of our purchases. In other words, instead of advancing from the two-car stage to the three-car stage, we are spending our extra income on travel, stereos, or videocassette recorders.

This wholesale shift in consumption has led to a decline in the need for raw materials such as petroleum, steel, and copper. And that has prompted a shift in the balance of economic power from nations well-endowed with raw materials to those that can count on other, more flexible resources.

Most economists did not anticipate this shift in consumption. Indeed, few even saw what was happening until long after the trend was well established. One of the most notable errors in foresight was the insistence of most economists and, for that matter, engineers that the demand for energy would remain fairly inelastic. As they saw it, energy demand would continue to grow in tandem with increases in GNP, much as it had for a decade or two earlier.

Admittedly, the magnitude of the changes that occurred was unprecedented. Prior to 1973, we had never experienced a fourfold increase in energy prices in such a short time. But given what seemed to be the inelastic and even rigid link between economic growth and energy consumption, most economists assumed that energy use would continue to grow despite price increases. It is instructive to recall just how far off our best estimates were. For example, in 1973, Exxon economists projected that energy demand in the non-communist world would grow from an existing level of 87 million barrels a day (MBD) to 125 MBD in 1980, 160 MBD in 1985, and 215 MBD in 1990.

But to almost everyone's surprise, the big increases in petroleum prices did make a difference: they prompted users to con-



*Americans have
changed their patterns
of consumption, reducing
the demand for raw
materials.*

serve. By 1980, Exxon's estimates of energy consumption had dropped to about 115 MBD for 1985 and only 125 MBD for 1990, the level once predicted for 1980. Given that actual energy consumption in 1984 was about 96 MBD—about what it had been in 1979—Exxon's 1973 estimates turned out to be about 60 percent too high. Even the estimates made in 1980 were off by 5 percent.

A Preference for Plastics

The drive to conserve energy changed our whole consumption profile. American consumers limited their purchases of cars and began spending their money on services and smaller, more compact appliances and products. Manufacturers adapted their products to this trend. For example, automakers quickly came to realize that one of the easiest ways to increase gasoline mileage was to reduce the weight of automobiles. Technological advances in plastics made achieving that objective possible.

According to data gathered by John Jacobson of Chase Econometrics, the average American-made automobile shed about 15 percent of its total weight between 1976 and 1984. That shrinkage—totaling about 500 pounds per car—has come at the expense of the steel industry. Today each car produced in the United States consumes 20 percent less steel than just 8 years ago. And current research in plastics and ceramics promises even lighter and more fuel-efficient cars—at further cost to the steel industry.

The same trend is reducing railroads' steel consumption, with freight cars now being made of aluminum instead of steel to save weight and increase efficiency. If steel consumption today accounted for the same percentage of GNP as in the mid-1960s, we would be using 175 million tons this year instead of just under 100 million tons, according to Chase Econometrics.

Steel-industry executives tend to blame their plant closings and corporate consolidations on increased imports, which now account for more than 20 percent of U.S. consumption. However, if steel use had grown by 60 to 75 percent as anticipated, instead of falling by 20 percent since the mid- to late 1970s, we could have comfortably absorbed the imports and still used much if not all of the now-abandoned domestic capacity.

Copper is another example of a raw material displaced by technological and economic factors. Though it remains the material of choice for transmitting electricity, copper consumption has fallen as the growth of electricity use has faltered. Furthermore, new technologies have reduced the size of copper conductors, and fiber optics are beginning to eliminate metallic conductors entirely.

The effects of such shifts in consumption go far beyond the workers and managers who find themselves unemployed or in different jobs. Just as firms specializing in the production of raw materials find themselves at a disadvantage, so regions of the world that are well-endowed with raw materials no longer command the economic and political influence they once had. This helps explain why the economies of areas rich in raw materials, such as Nigeria, Texas, and even Saudi Arabia, are no longer as robust as they were only a few years ago.

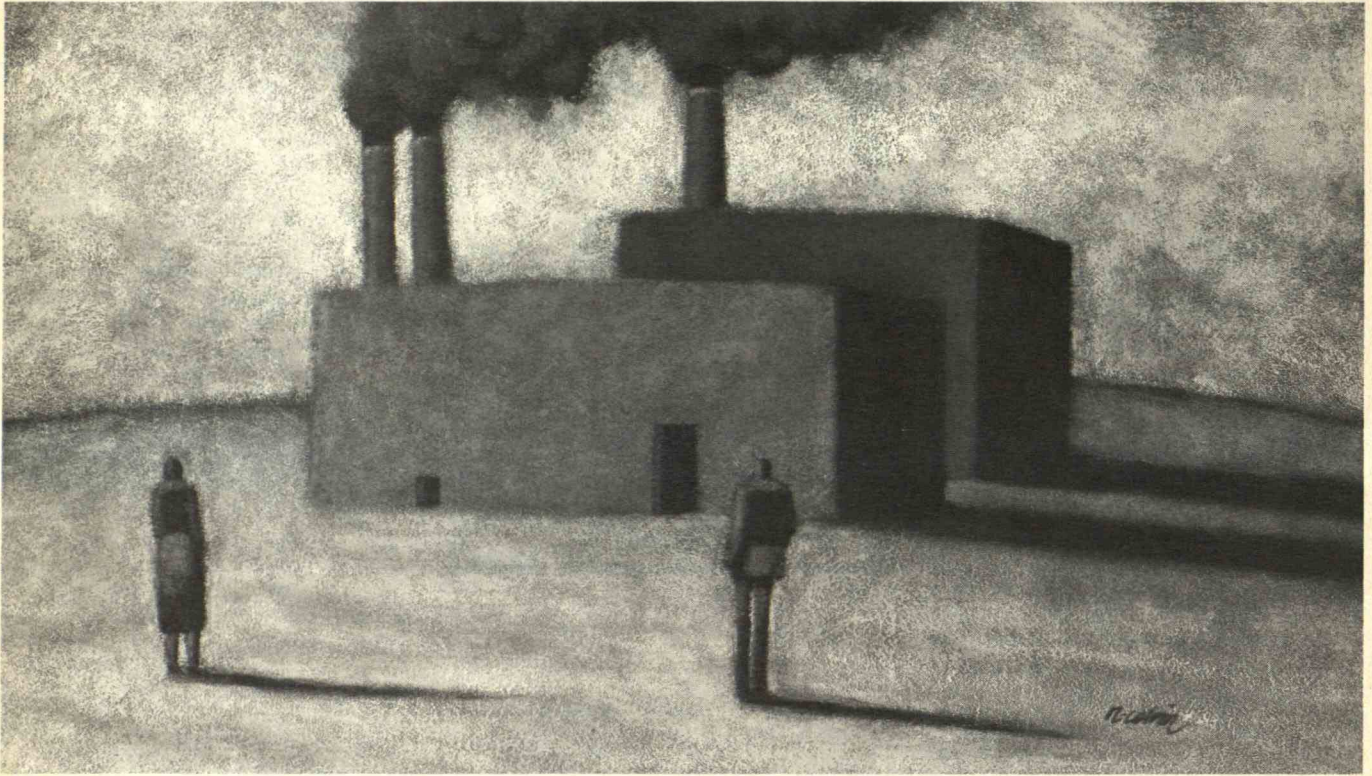
Does all this mean that we have been needlessly concerned about the effect of



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BY THOMAS H. MURRAY

Who Do Fetal-Protection Policies Really Protect?



GROWING numbers of companies are adopting policies designed to protect unborn children by excluding women of childbearing age from exposure to certain workplace hazards. These "fetal-protection policies" (FPPs) have run into stiff opposition from women's organizations and civil-rights advocates, prompting Congress to order a study of them by its Office of Technology Assessment (OTA).

Critics have two principal objections to FPPs. First, they argue that focusing on a woman's reproductive function is merely an old form of discrimination in a slightly new disguise. Second, they object to policies that would permit a company to demote or fire a woman who is pregnant or could become pregnant on the grounds that her fetus' health might be threatened by her job. Some perceive these policies as a violation of a woman's civil rights. Others have noted a suspicious correlation between exclusionary FPPs and those jobs—

especially heavy industrial jobs—historically dominated by males.

The OTA, in a report it expects to release this month, scrutinizes the legal, scientific, and moral validity of fetal-protection policies. The nonpartisan agency does not take a stand in this debate, but its findings should give companies that exclude fertile women from decent-paying jobs considerable pause for thought.

On balance, fetal-protection policies may be good or even necessary. After all, substances hazardous to fetuses exist. But two general questions need to be asked. First, does the scientific evidence support claims that fetuses need special protection in the workplace, and that such protection can be accomplished solely through the mother? Second, what is the moral case for protecting fetuses by excluding their mothers from jobs?

Fear of Litigation

The OTA makes no effort to determine how widespread a phenomenon FPPs are; it concentrates instead on several sample policies from companies such as Shell Oil,

du Pont, and Exxon Chemical Americas. Du Pont's policy is perhaps the most forthright: "Females of childbearing capability shall be excluded from work areas where: a. there is a potential for exposure to an embryotoxin for which an acceptable exposure level cannot be set, or b. whenever engineering and administrative controls, augmented as appropriate by personal protective equipment, are determined to be inadequate to insure acceptable levels of exposure." Du Pont's policy does not include the assurance that a fertile woman will be placed in a job with equal pay if she has to be moved to another area.

The OTA notes that many more companies undoubtedly have informal policies for deciding whether fertile women should be excluded from certain work areas on a case-by-case basis. Most companies adopt FPPs, formal or otherwise, out of fear that they will be sued by someone who was born with a birth defect allegedly caused by a parent's exposure at work.

The case for FPPs was bolstered last year when a federal court of appeals—ruling on a citation from the Occupational Safety and Health Administration (OSHA)—up-

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held an exclusionary policy at the Willow Island, W.V., plant of American Cyanamid Co. Cyanamid had announced that all fertile women would be excluded from holding jobs in 8 of the plant's 10 departments, and that all women between the ages of 16 and 50 were presumed to be fertile unless they could prove they had been surgically sterilized. Five women in a department producing lead pigments agreed to be sterilized to avoid losing their jobs, and two others were demoted to janitorial positions. In a suit separate from OSHA's, 11 women sued Cyanamid, and the case was recently settled out of court for \$200,000. The tragic irony here is that the lead pigments department itself closed a little more than a year after the women were sterilized.

A Weak Scientific Case

As the OTA report makes clear, the scientific case for excluding women is ambiguous at best. While it is true that much of the evidence of fetal harm comes from studies on women, the contrary is not true: there is little or no evidence proving that harm does not come to fetuses through their fathers—either from damaged sperm or after conception from toxins they bring home from work. In fact, there is a strong likelihood that men working in hazardous areas are also exposed to reproductive toxins. When the effects of substances found to be reproductive toxins in women are tested in men, they are commonly found to be toxic there as well. The problem is that the great bulk of research on the reproductive hazards has been done on women, and very little has been done on men. Hence, even though fetuses may be harmed through their fathers, men are permitted to work where women aren't.

Fetal-protection policies are based on a second questionable supposition: that substances may be uniquely harmful to fetuses at exposure levels harmless to their parents. Research more often than not confirms that substances that are teratogenic (causing defects in developing organisms), such as lead, ethylene oxide, vinyl chloride, and dioxin, are also mutagenic (causing mutations in cells, including sperm and ova) and carcinogenic.

What we know about the biochemical changes underlying these three processes suggests that they are fundamentally similar. Because it is likely that workplace ex-

posures will be as harmful to adults as to a fetus, it would be prudent to treat with great care any substance found to be a teratogen, even if proof of its cancer-causing potential has not yet been established.

Perhaps proponents of exclusionary FPPs stress the danger to the fetus over the danger to the parent because the former has not consented to this risk. The parent, on the other hand, can decide what is an "acceptable" risk, and has implicitly consented to whatever risks he or she encounters by taking the job. But now the ground has shifted beneath us: we are no longer arguing about the science of reproductive hazards. We are arguing about ethics and legal liability. Employers have often used the notion of implicit consent—"assumption of risk"—to argue that they are not liable for an employee's injury.

Where Is the Moral Wrong?

Imagine the most unambiguous case of reproductive harm: a fetus suffers a grievous though nonfatal injury. It is not aborted and instead is born to live with a severe, life-long disability. Does the prospect of this outcome justify a policy that would exclude its mother from a job?

In significant measure, our answer turns on the probability and likely severity of harm. Granted, we may yet uncover some workplace hazard that does gross harm to fetuses with numbing regularity without posing a significant risk to mother or father—an occupational thalidomide. But we have not found it yet. Far more likely is the chance that a substance harmful to a fetus is also harmful at comparable exposures to its parents. So, for most or all hazards now known or likely to be discovered, the probability of serious harm to the fetus—at levels deemed acceptable to adult workers—is going to be low.

Can morally responsible parents ever justify exposing their unborn child to a risk of serious harm, even if the probability is quite low? Certainly, no parent worth the name would do so frivolously. In answering this question, we should keep in mind that our duties to the fetus are not unique. We have duties to other people who depend on us, not least our children. Whatever our moral responsibilities might be to a fetus, they cannot exceed our moral duties to our born children.

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Continued on page 20

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BY WILLIAM N. TAYLOR

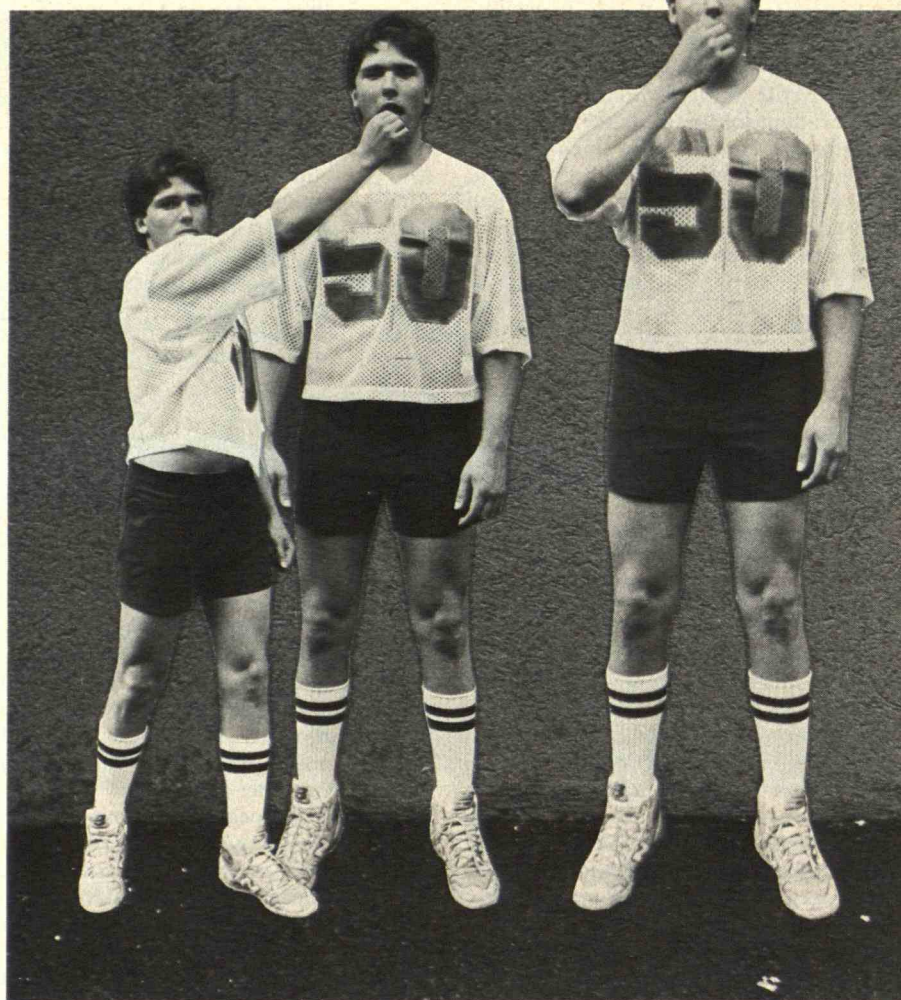
Growth Hormone: Preventing Its Abuse in Sports

A FEW years ago I began receiving queries from athletes, including Olympic hopefuls, who had somehow obtained a supply of human growth hormone (hGH) and wanted advice on how to use it. I also heard from a few fathers who wanted to administer the hormone to their sons to give them a height advantage in basketball and football. I had always thought that hGH was being used only on a strictly experimental basis to treat certain types of dwarfism in children. Even for those patients, I had heard that the hormone was in scarce supply because it had to be painstakingly extracted from the brains of human cadavers. Yet athletes and parents were obviously able to obtain the substance for unauthorized use. So much for scientific controls.

Today, several biotechnology companies are poised to market new synthetic versions of human growth hormone produced by recombinant-DNA techniques. At least one company, Genentech, expects to receive approval sometime this fall from the Food and Drug Administration (FDA) to market synthetic hGH in the United States as a general prescription drug. Once that happens, any physician will be able to prescribe hGH, and I foresee its widespread abuse by athletes and parents who place an excessive premium on height. The FDA should act now to classify synthesized hGH as a controlled drug, much as Valium, amphetamines, and narcotics are controlled to prevent their misuse.

Produced by the pituitary gland of the brain, hGH plays a key role in normal human growth and development. When released into the body, the hormone affects nearly all aspects of bone growth, including bone length. Research has shown that children's rapid growth during puberty corresponds with the greatest release of growth hormone. The more growth hormone is released, the faster and taller the body grows.

Human growth hormone also stimulates the transport of amino acids among cells, enhancing the synthesis of proteins. Recent evidence from cells grown in petri dishes suggests that a rise in protein syn-



thesis increases both the mass and the number of skeletal muscle fibers, which builds muscle strength. The same hormone has also been found to stimulate the production of collagen, the key protein in connective tissue that essentially serves as the body's glue for attaching tissue to tissue. Collagen is essential for the growth and strengthening of bone, cartilage, tendons, and ligaments. Hence, as the muscle bulk becomes stronger owing to the release of hGH, so too do the muscle attachments.

A New Breed of Giants

Clinical trials have proven that extracts of natural hGH are effective in treating certain types of short-stature disorders in children. Research also shows that hGH given to short children with normal growth-hormone levels accelerates bone

growth. However, doctors know little about the results of administering hGH to children and adults with normal growth-hormone levels.

Doctors do know what happens in adolescent patients who suffer from a rare condition known as acromegaly, or "gigantism," caused by long-term overproduction of hGH. The disease is characterized by bone overgrowths throughout the body, including the jutting out of the forehead and eyebrow regions, overbite of the jaw, and abnormally large hands, fingers, feet, and toes. Overgrowths of bone where the tendons attach are common—often visible as lumps under the skin. Patients with acromegaly usually suffer from diabetes and heart disease and have a shortened life span. Impotence is also a symptom of this disorder.

At this point it is impossible to say

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whether the repeated use of hGH in athletes or youths will cause any of these conditions. However, there seems to be little doubt that chronic administration of hGH through the growing years could result in supranormal growth. I call this condition "selective gigantism," and there is some evidence that it exists among a few abnormally tall athletes in the Eastern Bloc. Apart from the possible long-term health hazards, this kind of abuse also gives some athletes an unfair advantage in competition. For both reasons, it should be curtailed.

Although I have yet to see evidence of "selective gigantism" in the United States, adult American athletes are using hGH obtained on the black market in increasing numbers, according to trainers and physicians specializing in sports medicine. In a letter to me in 1984, Dr. Robert Voy, chief medical officer of the U.S. Olympic Committee, said, "My impression is that we now are facing the issue of human growth hormone." Shortly after that, Dick Brown, head coach for Athletics West, a major track and field club, told me that "30 to 50 percent of my Olympic athletes were using hGH," and that he was worried about their health. The trainer at the same club corroborated his comments.

I then found out that a California physician was actively administering hGH to a wide variety of athletes, including Olympic athletes from the United States and other countries. This physician was not violating any law since natural hGH extract is a general prescription drug. Whether he was violating medical ethics was another issue.

I had been led to believe that hGH could be obtained only from the National Hormone and Pituitary Program (NHPP) by endocrinologists with strict evidence of clinical need, including a battery of x-rays and other tests that show evidence of a pituitary disorder. The NHPP is a federally funded research program that buys hormone extract from the two drug companies making it and distributes it to physicians treating dwarfism in the United States. How then could all these athletes get their hands on this drug?

I soon found out. I sent simple prescriptions for hGH to all three sources—the NHPP and the two drug companies, Serono Labs and Pharmacia Laboratories—with no further information. I received no hGH from the NHPP, but both Serono and

Continued on page 30



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How Not to Buy a Personal Computer

My Personal Computer and Other Family Crises

by Ben Schneider, Jr.
Macmillan, \$15.95

Reviewed by Ellen Williams

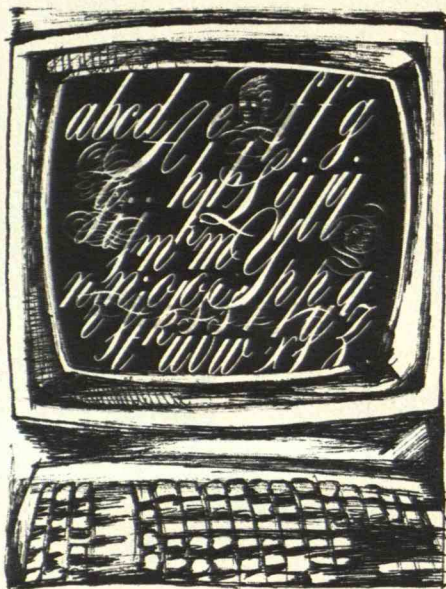
"Beware the Jabberwock, my son
The ads from Byte, this clause, that catch
..."

With a single stroke, Ben Ross Schneider, Jr., has created a new genre: the autobiographical high-tech travelogue-cum-fantasy. In *My Personal Computer and Other Family Crises*, Schneider tells of his efforts to acquire a personal computer and the effects on his health, career, family, finances, and perceptions of technology, communications, and the American Way. As befits the writings of an English professor, the book abounds with literary allusions—to Melville, Carroll, Yeats, Dickens, Faulkner, and Byron, among others, as well as, of course, the Bard himself. Clearly this is neither your ordinary how-to-buy-a-computer handbook nor a behind-the-scenes peek at computerniks in action. It is a delightfully rendered, deeply personal account of the trials and tribulations of someone who just wanted to make the available technology—get this—do something useful for him.

The author opens by explaining the circumstances that led him, late in 1979, to decide that he needed a personal computer for word processing. He has just completed a massive nine-year research effort involving much word processing on an IBM 360 and a DEC PDP-11. So he sets out in search of a system that will offer him—as they say in the trade—functionality equivalent to his mainframe-based system.

Strange Encounters

His first stop is the local computer store. The only person who benefits from that enterprise is the reader, who is treated to a witheringly funny account of indifference in action. Schneider is passed from one enterprising salesperson to another like a hot dog at a football game. Bob, the last in this illustrious line, gets as far as



discovering that Schneider wants to write books with his computer and concludes, skeptically, "I suppose ... you would want ... lowercase."

Following this strange encounter, Schneider adopts a do-it-yourself route: he specifies a system for himself by reading the ads in *Byte* magazine, noting the most oft-mentioned attributes and choosing components that offer them at the lowest price. Now it may be possible to configure a stereo system that way, but woe betide anyone who tries to sling together CRTs, CPUs, printers, and software from different manufacturers using such an approach. And indeed the remainder of the book is devoted to cataloging those very woes.

Schneider makes the mistake of assuming that the Englishlike language used to describe computer components is, in fact, English. But it is really pidgin computereze, a language remarkable for its compactness and its unstated premises—both deriving from the culture of the industry's creators rather than from any malicious intent to deceive. But deceive it does. It leads the uninitiated to reason that if program Alpha can run under an operating system (CP/M) on computer X, and if CP/M can also run on computer Y, then program Alpha can also run on computer Y. Unfortunately, that is often not the case.

Of course, the author brought many of his woes on himself. He had acquired enough experience in his nine years of dealing with mainframes to observe early

on that "computer technology was a closed circuit whose purpose was the satisfaction of its own ends, the main one being to perpetuate itself. It could accomplish miracles in its closet but never seemed to get the point of what it was doing. It could fabricate brilliant gadgets that failed to serve their purposes. ... It preferred the complex to the simple, the clever to the easy." Yet Schneider still proceeded with a strategy that, he argues, *should* have worked. Caveat emptor.

However, in the final analysis, the computer industry *did* fail Schneider, first by not marketing the product he wanted to buy, and ultimately by abdicating responsibility for what it did market. Despite the fact that IBM's entry into the personal-computer market has since helped standardize some of the components, Schneider's problems remain a potent indictment of the industry, and his concept of what *should* be a rational buying procedure is far from unreasonable.

The whole business of slinging together components, including software, so that they coalesce into a system that works in a predictable and desirable fashion goes by the name of "interfacing." Most manufacturers' literature loudly trumpets the virtues of the computers themselves while dismissing the whole matter of interfacing with a few vague mumbles. Even if more detail is forthcoming, key facts needed to make components work together either are not noted or are not made clear. This is like touting the convenience of an automobile without mentioning that it needs fuel regularly, or without bothering to say what kind of fuel it needs.

To my mind, all the failings of the personal-computer industry derive from this original sin of failing to communicate both accurately and completely. Personal computers are very new, as well as very demanding, products. Most buyers are not familiar with them, and therefore companies must use something more sophisticated than toothpaste jingles to market them. Buyers fill the vacuum of the lack of information with expectations that the products cannot possibly meet. Many computer firms are unable to cope with the disappointed customers that follow.

Back to Schneider, though, who doggedly pursues his dream system in the face of such difficulties, finally bullying his components into a responsive configuration. Throughout his tale he interleaves

*Business and government
are more often partners than opponents.*

sophisticated technical details with the comings and goings of four children and philosophizing about the relationship between poetry and technology. With the exception of one misguided chapter in which Schneider tries to classify word-processing hardware, this is a tale to be savored by those interested in a clear perspective on the workings of the high-technology marketplace. The moral of the story? Know Thy Interfaces. □

ELLEN WILLIAMS, a free-lance writer, was formerly associate commissioner of the Food and Drug Administration.

When Government Regulates Industry

The Adversary Economy
by Alfred A. Marcus
Quorum Books, \$35

Reviewed by Harvey Sapolsky

Newspaper op-ed pages and television interview programs usually present us with exaggerated polemics in an effort to make the complex simple while also being both entertaining and fair. The public must deal with left versus right, hawk versus dove, businesses versus consumers or some other set of extremes while seldom receiving the reflective, moderate view. Such debates are often lively but rarely illuminating. We learn a lot about what the committed believe but very little about the policy issues supposedly being examined.

Alfred Marcus tries a different tack in analyzing U.S. business-government relations. The economic system he describes is not one in which business always captures the policymaking process and subverts its to its own ends, or one in which government forces business to operate inefficiently through myriad bureaucratic regulations. Instead, the American economy is based on a complex system of subtle interactions between government and business that produces advantages and disadvantages for all participants. There is much to learn about our mixed economy in Marcus' discussion of this interplay. Unfortunately, it is also very dull reading.

Marcus has a fetish for lists and an annoying tendency to cite everything that he has ever read on a topic. It's my guess that he had accumulated an enormous pile of



note cards and did not want to fail to use every one at least once. Many times during the slow trip through the book I longed to find an unread op-ed page or a listing for the next Jerry Falwell-Ted Kennedy TV debate.

This is all quite regrettable because Marcus presents what I consider to be the correct view of American business-government relations. Marcus knows that business and government are partners more often than opponents, and that governments at all levels provide business with a vast array of direct and indirect subsidies. Indeed, far from restraining economic growth, government is frequently its source. Where, for example, would the U.S. medical-equipment or computer industries rank in the world without the stimulus that government has provided? The subsidies offered to these and other industries total billions of dollars.

Exaggerated Threat

Unlike the governments of other industrialized nations, ours rarely competes with business. We lack significant government enterprises in telecommunications and transportation, for example, and are probably better off for it. Technological progress and consumer benefits appear to be enhanced when government refrains from managing key sectors of the economy. Remarkably little of our political life is devoted to debates over the need to close

or curtail outdated nationalized industries because remarkably little of our economy has ever been nationalized.

What government does in the United States, although not necessarily with great effectiveness, is regulate business. And business does not always oppose this regulation. On the contrary, as Marcus notes, much regulation results from companies' desire to stabilize competition within a market. That this stabilization comes at the expense of consumers and potential business rivals is not lost upon most regulated firms. And yet, despite the desire of regulated firms to maintain their protected positions, a variety of markets has been significantly deregulated in recent years. There is more flexibility in business-government relations than some business leaders might prefer and most of their critics are willing to admit.

The antagonism that does exist between business and government stems largely from the social rather than the economic regulation of business. The wave of environmental, health, and safety regulations enacted beginning in the late 1960s resulted from the efforts of public-interest groups. Managers felt threatened because these regulations appeared to limit their prerogatives and lower their social standing. But as Marcus points out, the threat to firms' well-being was exaggerated, for social regulation has provided business with both new economic opportunities and new protection. Alert firms sought growth by producing pollution-control equipment and marketing their reputation as socially responsible citizens.

Marcus devotes much of this mistitled book to advising firms on how to deal with this wave of regulation, yet his suggestions are rather mealy-mouthed. Mostly he counsels careful analysis of the possible effects of regulation, with opposition sometimes an effective strategy and accommodation sometimes best. Wise guidance perhaps, but not the type likely to be judged very helpful by the harried executive whose most profitable product has just been labeled a health hazard, or whose plant is being cited for safety or pollution violations. Like the casual reader, the executive will probably hope for something more exciting than the truth. □

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*Can experts defend their
client's case while maintaining their
scientific honesty?*

Expert Testimony on the Stand

The Atom and the Fault

by Richard Meehan

M.I.T. Press, \$13.95

Reviewed by Lee A. Swanger

In *The Atom and the Fault: Experts, Earthquakes, and Nuclear Power*, Richard Meehan considers the role of scientific experts in the legal process—specifically, in licensing hearings for nuclear plants. Meehan, a geophysicist who evaluates geological risks to the plants, does not try to convert his audience to a pronuclear or antinuclear view. Rather, he asks whether experts can maintain their scientific objectivity in such an adversarial arena. He also questions the accuracy of a process that emphasizes procedural details over technical concerns about plant safety.

Meehan's interest in the proper role of the expert witness arose out of his role in testifying about the probability that ground-fault ruptures—the displacements of the earth that occur during earthquakes—could affect reactors at two sites in California. He gives insider accounts of hearings on the safety of the Vallecitos reactor, the nation's first commercial nuclear power plant, which operated with complete safety from 1957 until challenged in 1977. He also describes the licensing hearings for the Diablo Canyon reactor, whose start-up has been delayed while adversaries debate the threat of an offshore fault to its safe operation.

As with other technologies, the opinions of experts concerning the safety of nuclear power plants do not determine whether to proceed. Instead, scientists' views on how well a system will work are compared with society's concept of acceptable risk. The experts quantify risk through probability, expressed as the likelihood that a particular accident will occur during one year of operation.

Meehan uses the case of dam construction to illustrate this connection between engineers' and the public's view of safety. Dams clearly present a safety risk: the one in Vaiont, Italy, killed 3,600 in 1963; the one in Maupassant, France, killed 421 in 1959; and the dam in Italy recently killed 450. To what safety standard are dams built? Meehan quotes an engineer: "We design them in accordance with the state



of the art. If something goes wrong, and the expert witnesses at my trial say that I built [a dam] according to this state of the art, then I'm not negligent. The state of the art sounds very scientific, but it's just . . . an implied understanding among engineers that this level of safety is what society expects, even though we could build them safer."

Similarly, federal regulations impose no objective safety standard on nuclear power plants. Instead, the state of the art is subject to debate among the participants. This debate occurs in public hearings before atomic safety and licensing boards (ASLBs), which consider the safety of the design and construction and operating procedures for the plants. Each ASLB consists of a lawyer, who chairs it, and two senior scientists or engineers.

The ASLB gives the public the right to question the safety of a proposed nuclear licensee. These "intervenor"—usually coalitions of environmental and citizens' groups but sometimes also local government officials—hire an attorney, who in turn hires consultants to testify in support of the intervenors' point of view. The ASLB decides which "contentions" they raise should be litigated.

Because of the adversarial nature of the ASLB hearings, the expert witnesses must confront a conflict in their roles. Can they defend their client's case while fulfilling their obligations as arbiters of scientific truth? The experts are under considerable pressure to abandon the ideal of scientific

detachment and become advocates for their views, especially during cross-examination. Of course, scientific progress has always required advocates: consider Galileo's challenge to the astronomical theories in of the Catholic Church.

The legal system exacerbates the pressure on expert witnesses by treating them as special. Most witnesses in a legal proceeding must limit their testimony to events about which they have firsthand knowledge; they cannot offer conclusions or opinions. In contrast, expert witnesses are considered qualified to form opinions and draw conclusions based on their own and others' work. Experts who base their views on thorough investigations will be able to remain objective. However, not all do such a thorough analysis.

In spite of these drawbacks, Meehan concludes that this adversarial system can achieve the results society desires. If the adversaries each present their best case and raise reasoned challenges to their opponents' opinions, he thinks that the process will yield designs that minimize society's risks.

Of course, each side must have access to experts of comparable experience. Meehan concludes that intervenors, including the U.S. Geological Survey, have successfully challenged utilities' claims that geological disruptions pose little danger to nuclear plants. However, intervenors have been less able to mount meaningful challenges in safety-related engineering—as opposed to scientific—areas. Yet these concerns are crucial since, as Meehan says, "The 'engineering judgment' of experienced practitioners" cannot assure "that nuclear power plants are designed, built, and operated" to required standards.

The well-known weakness of intervenors' expertise in engineering is partly due to their limited financial resources. An intervenor with one of the lowest budgets is a retired chemist in North Carolina, who has provided the only opposition to four nuclear projects of Duke Power Co. The presiding ASLB recently canceled hearings on a key safety system when the intervenor could not afford even one expert witness to support his case.

Yet there is some evidence that money does not guarantee effective representation. Perhaps the best-financed intervention has occurred on Long Island, where Suffolk County and the State of New York have opposed the licensing of Long Island Lighting Co.'s completed Shoreham nu-

clear power station. Suffolk County spent over \$1 million during three months of hearings to challenge the same safety system that was not even litigated in North Carolina. Even with these resources, most participants concluded that the experts willing to testify for the intervenors were inferior to the team assembled by the utility. Intervenors' experts are often less effective because they view their role as critics rather than as design engineers.

If the quality of expertise intervenors can obtain is to improve, it will be because of the efforts of engineers like Meehan, who convince their peers that adversarial proceedings are a legitimate vehicle for making social decisions on the safety of advanced technologies. □

LEE A. SWANGER, an engineer with Failure Analysis Associates, headquartered in Palo Alto, Calif., has been a consultant to Duke Power Co. and Long Island Lighting Co.

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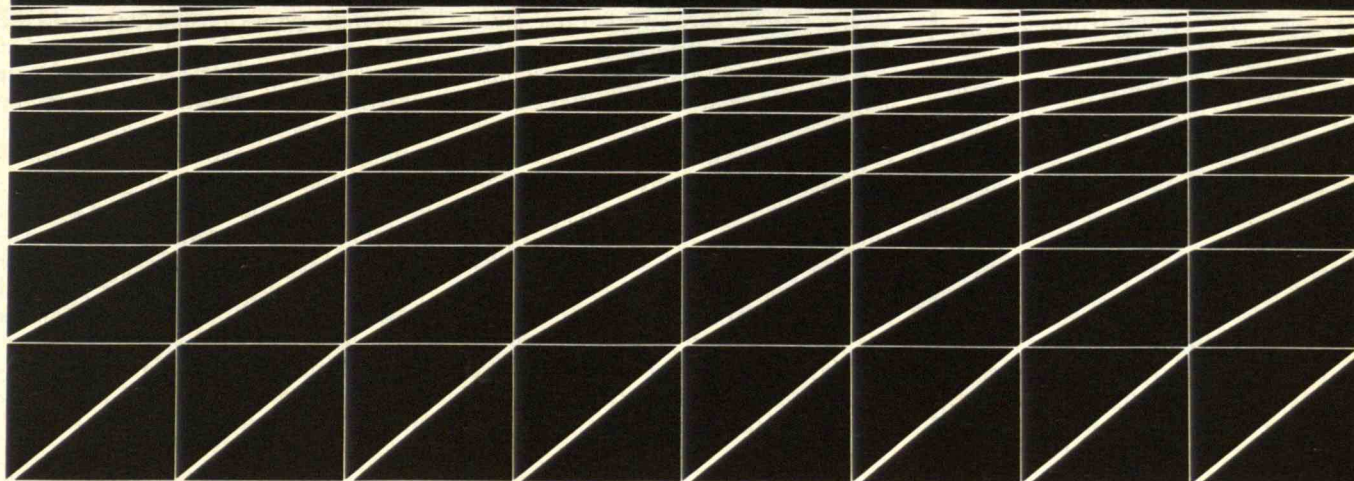
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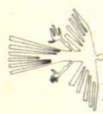




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GOLDMAN

CONTINUED FROM PAGE 11

exponential economic growth on dwindling world resources? Not at all. Raw materials are indeed in finite supply. However, what the authors of *The Limits to Growth* did not anticipate is that as a shortage becomes acute, the resulting price increases become its cure—at least temporarily.

This suggests that trade protections and tariffs are not long-term solutions for industries such as steel that are under pressure from imports. Higher prices simply force users to conserve or substitute, and impel companies to spend more to recover ores that were previously unprofitable. This is not to say that shortages of raw materials will not recur. However, the near-term access to these materials has not proven as crucial to economic well-being as most experts were predicting barely a decade ago.

With command over raw materials becoming less important, what counts is an adequate supply of engineering and scientific talent, together with a workforce that is vocationally skilled and relatively cheap. These resources explain the success of raw-material-deprived regions such as Japan, Taiwan, South Korea, Hong Kong, and Singapore. Those areas have seen impressive economic growth that is the envy of other countries.

This is not to imply that a country is always better off without raw material wealth. If raw materials are treated as a very scarce resource and not permitted to create a false sense of security, they can be important to a nation's economy. However, economic strategists today would do better to stress the importance of high-tech R&D—both in revamping production processes and in devising technologically sophisticated products to stay ahead of foreign competitors.

To maintain our leadership role in the rapidly shifting balance of economic power, U.S. industry and government must work together to ensure the existence of three key components: a scientifically skilled and literate workforce, a climate that encourages entrepreneurship and innovation, and an abundant supply of venture capital.

We need the strength and flexibility that these three components can give us to cope with whatever the future holds. Nations that fail to marshal these forces will end up like those who based their economic strategy on the inevitability of growth in the consumption of raw materials. □

MURRAY

CONTINUED FROM PAGE 13

a massive collective of petrochemical plants in a community known as Texas City. Texas City is a "cancer corridor"—people who live there have a statistically higher risk of developing cancer than those who live in neighboring towns, presumably because of their proximity to the plants and their emissions. Suppose a man living elsewhere were offered a higher paying job in Texas City. Accepting it and living there would mean exposing himself and his family to a low but still increased risk of cancer. But it would also mean a higher standard of living for them all, better schools, and other advantages.

Would we say of a man who accepted that job that he has done something morally wrong? Should we deny jobs in Texas City to men and women with children on the grounds they are exposing their unconsenting offspring to the risk of harm?

We might lament the fact that men—and women—must face choices like this at all. We might be moved to ensure that decent, safe jobs are available in communities with clean air and water. But we would *not* say that this man has made an immoral choice. He has made a difficult judgment about what is best for himself and his family, all things considered. It is a decision fraught with the elements of tragedy, but it is not immoral.

I do not see that a woman who refuses to give up a decent job, even though it means exposing herself and a potential fetus to some small risk, is doing anything different from the man who packs up his family and moves to Texas City in search of a better life for all of them.

A Fairer Policy

We should do everything in our power to assure that women—and men—are not faced with unconscionable choices. As the OTA report notes, there is another option open to those genuinely concerned about the welfare of the unborn: cleaning up the workplace for everyone. Reducing or eliminating exposures would benefit workers and their offspring alike. If special attention must be directed at pregnant women, then transfer with retention of salary, seniority, and other benefits would not force women to choose between their jobs and the welfare of their children-to-be. Policies such as these are infinitely better than scientifically unwarranted and morally misguided efforts to "protect" fetuses by firing their mothers. □

Mr. Lasser is correct in observing that "unlike Kennedy's challenge, Reagan's proposal was designed to have more than symbolic importance." Routine space operations, which include the space-shuttle and space-station projects, have become crucial to our national security, scientific progress, and commercial competitiveness. These interests are a firmer foundation on which to build than the political imagery of earlier years. Nationwide polls confirm Americans' enthusiasm for both the symbolic and practical benefits of the shuttle program. Tens of thousands of Americans regularly turn out for launches and landings, and thousands are active in groups such as the L-5 Society, the National Space Institute, the American Space Foundation, and the Planetary Society.

Breakthroughs such as the space shuttle have been created under tough fiscal constraints. The current budgetary environment is not the first struggle NASA has

faced. It has continually aided the birth of new technologies that eventually became part of our economy. Creating dreams such as the shuttle, space station, and eventually a lunar base, and transferring these to the private sector or other agencies as the dreams become routine, is part of NASA's mission. The space station is just another step in the history of this unique and visionary government agency.

Scott Pace
Long Beach, Calif.

William Lasser thinks Washington decision makers approach the NASA budget with one eye on an imagined public "applause meter." In truth, politicians have a healthy respect for the virtues of the space program and the admiration the effort commands from the public. Yet it is simply too easy for them to erode civilian space funding in the absence of a definitely perceived prospace voting bloc. Space advo-

cates by nature have avoided political brouhaha. If they became more vocal, then we would have to treble the current negligently dole to civilian space.

Eugene F. Mallove
Holliston, Mass.

The author responds:

I wish I could be optimistic about NASA's future. I harbor no ill will toward the space agency, and in fact I strongly support increased expenditures for basic exploration of space. Unfortunately, NASA's future role in managing space R&D may be less substantial than many of the above correspondents would hope.

In the short time since my article was written, there have already been ominous developments for NASA. One of the most serious is the suggestion by a presidential commission that the government's R&D programs be consolidated in a cabinet-

Continued on page 53

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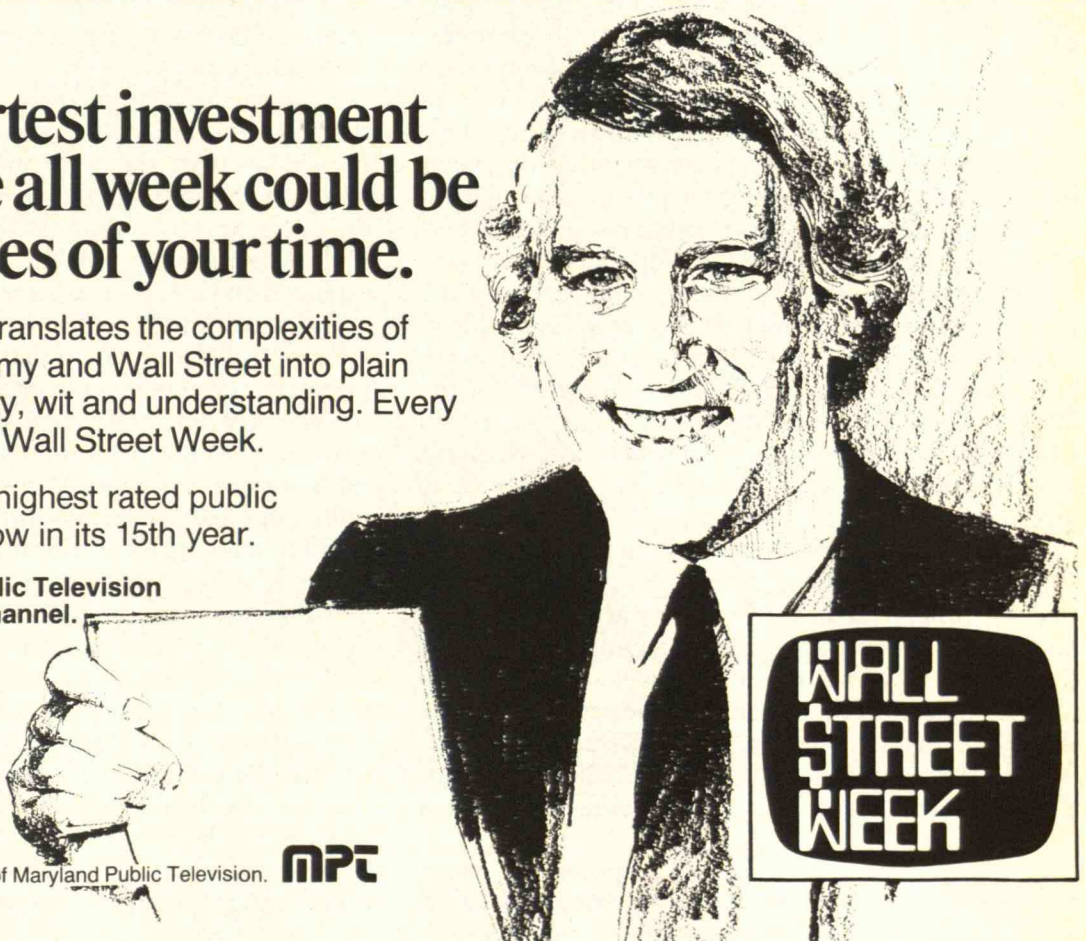
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*Despite teething troubles today,
the two-way transmission of text and graphics
promises to become commonplace.
Its acceptance will alter the news media
and raise important
social questions.*

The Inevitable March of Videotex

BY RALPH L. LOWENSTEIN AND HELEN E. ALLER

IN its potential to deliver vast amounts of information at the user's request, videotex has no equal. The interactive method of communicating text and pictures between a central computer and home receivers can eliminate the delays and costs associated with print on paper, be it a business letter, a news story, or a magazine article like this.

Videotex subscribers who hear an interesting news bulletin on their car radio, for example, could, on reaching home, switch on their television set or personal computer and call up the local videotex service. With a touch of a few keys, they could pick up the latest account of the event on the screen, in exhaustive detail. If they wanted, they could read every word filed about the story by reporters on the scene. What's more, they could do this—as well as perform tasks such as banking, booking hotels, and perusing a new novel—just as easily at 2 A.M. as in the early afternoon.

Competing with newspapers, which are limited by space, and with radio and television, which are limited by time, videotex offers liberation to readers and audiences. But so far, the technology has not lived up to the claims of its pioneers in the United States. Not one of the dozens of American companies that have invested millions of dollars in its development has reported success on the scale of the Apple II or the Xerox copier. Several have failed completely.

Despite this history of unfulfilled potential, major U.S. corporations continue to sink money into videotex each year. In part, this reflects their knowl-

edge that the technology has proved successful in Europe—notably in France. But these companies also realize that videotex is the quintessential medium of the twenty-first century. If it did not exist, we would have to invent it all over again.

Because the technology of videotex sprang onto the scene so fast, and continues to change rapidly, no one has been able to define the terms of the technology accurately enough to make them stick. Even the spelling is a source of controversy; until about a year ago, a large portion of the industry insisted on the form *videotext*. However it is spelled, the term denotes to many the entire wide-ranging field of electronic publishing. But it has come to mean more precisely the narrow technology of two-way electronic communication.

In this limited definition, videotex is the generic term for transmission of text and graphics on an interactive basis, typically through a telephone connection between a home terminal and a central computer. The two-way nature of the link means that subscribers can send requests upstream to the central computer, which in turn gives them access to hundreds of thousands of pages, frames, or TV screenfuls of information. Subscribers can also transmit information as well as receive it. The interactive nature of videotex sets it apart from such one-way systems as cabletext, which provides the viewer with fresh pages of information at regular intervals, and teletext, which enables viewers to select from a limited number of pages, but not to send commands to the central computer.



Videotex also differs, although only slightly, from online databases and other vast electronic storehouses of information. The chief distinction is that early videotex services emphasized color and sophisticated graphics. Most databases—which route specialized information into computers owned by business customers such as attorneys, stockbrokers, travel agents, and librarians—have no color and only crude graphics.

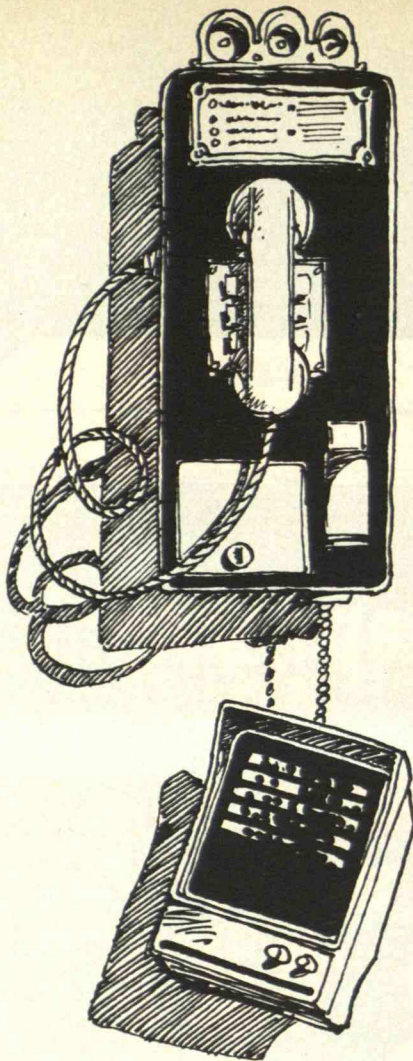
Early videotex differed from databases in several other respects. Entrepreneurs reasoned that, in order to attract the home consumer, videotex needed to display its wares on the standard TV set, and to feature software that was simple and unthreatening. And to further the appeal to the home consumer, most videotex services kept their prices relatively low, charging a flat monthly rate of about \$10 or an hourly charge of roughly \$1. By contrast, the online databases that serve corporate America cost from \$20 to more than \$100 per hour.

However, the distinctions are beginning to blur. The 1985 videotex marketplace features a greater reliance on personal computers for display and less reliance on the color and graphics that distinguished early services. And the uses of videotex are aimed increasingly at businesses rather than homes.

Videotex Overseas: Signs of Success

Western Europe has seen the most vivid flowering of videotex. In Britain the closed-caption process for deaf TV viewers developed by British Broadcasting Corp. engineers in 1971 was quickly expanded to deliver general information via TV signal. The cost of this teletext system is now absorbed into the rental costs of TV sets (very few Britons buy their sets outright). Last year Ceefax, as the system is known, was available in 1.36 million British homes, with a potential audience of 4.75 million.

Britons can also call up a true videotex system—an interactive service named Prestel that is delivered over the telephone lines. With a database of 317,000



frames of information, it serves almost 50,000 subscribers. Larger success eludes Prestel, however, because of a confusing pricing scheme, with different charges for different types of information.

In terms of market penetration, the world leaders in videotex are the French. In 1983, the state-owned French telephone service introduced the Minitel, a small terminal without color capability that costs only about \$150 to produce. The telephone company gives Minitels free to telephone subscribers, who pay nothing for directory information on other subscribers in the same area. The cost of other videotex information varies according to its type and source.

The primary information available to Minitel subscribers consists of telephone numbers. In fact, the telephone system justified the project commercially by arguing that it would eliminate the huge cost of paying directory-assistance operators and updating telephone books. But the system also gives subscribers access to more than 1,000 news and information services linked to the main database. These include weather forecasts, hotel and airline reservations agents, games, restaurant guides, first-aid instructions, listings of doctors and pharmacies on weekend call, TV schedules, Yellow Pages, real-estate listings, home banking services, and major stories from national and local newspapers.

The French government has already distributed more than 1 million terminals to telephone subscribers, and hopes to have more than 1.5 million homes connected by the end of the year. Ultimately, it will stop printing telephone directories altogether.

The U.S. Industry: Ups and Downs

The U.S. videotex industry has made less progress. The industry expected average homeowners to purchase videotex from the start. But that group was, and remains, unused to paying a lot for information. Consumers balked at the expense of the equipment needed to receive the service and the high transmis-

France leads the world in market penetration by videotex, through the Minitel terminals distributed to subscribers by the state-owned telephone service. Unlike U.S. systems, Minitels boast no color or sophisticated graphics, and

their primary purpose is to provide directory information. But they also give subscribers access to more than 1000 news and information services, such as air, rail and hotel reservations, banking, and stories from newspapers.

sion costs once they became subscribers. A major roadblock has been the \$600 price tag on the decoders, which translate data into a readable format on the TV screen, and the terminals, which enable the user to call up specific information. True, consumers are willing to pay more than that for a stereo system or videocassette recorder, but those are entertainment. Information simply isn't as desirable if it comes with a high initial price tag. And though advertising could underwrite some of the users' costs, advertisers won't become interested until the services have signed up large numbers of consumers.

U.S. communications giants seem to take an ambivalent view of videotex. They fear losing huge amounts of capital if they invest in the business in its experimental phase. Yet they dread the threat of future competition from the medium if they don't.

Unfortunately for investors, success has eluded videotex projects to date. Several small companies have begun videotex services, only to withdraw defeated. Others have quietly experimented with the new medium and decided not to begin an actual service. And in the past two years, two major disasters have made the headlines.

The most recent large project to pull up stakes was Keycom Electronic Publishing's "Keyfax" videotex service in Chicago. Originally a joint venture among the *Chicago Sun-Times*, Honeywell, and the telecommunications giant Centel, Keyfax was a consumer-oriented service that never attracted more than a few hundred subscribers. The system did not market its services effectively, and its price tag was high. By this past June, one year after it began, the system had lost Centel's two partners, laid off most of its employees, and announced that it would abandon the consumer market and "refocus" on business users.

Two years ago, Time, Inc., announced that it would not market its experimental \$30 million non-interactive teletext service, designed for delivery over cable TV channels. The major problem was the one-way nature of the product. While Time's service promised to deliver a large amount of news and information, it could not provide shopping, banking, or transactional services because it was to reach the home via cable rather than a telephone connection. Even in its limited form, the experimental system was down as often as it was working, largely because of the well-known susceptibility of cable amplifiers to bad weather and interference.



But like the phoenix rising from the ashes, Time recently announced a born-again videotex joint venture, in collaboration with AT&T, Bank of America, and Chemical Bank. The new company, named Covidea, will offer two-way transactional services via phone line to owners of AT&T personal computers nationwide.

The experience of Knight-Ridder Newspapers, Inc., the most visible developer of home videotex in the United States, is similar to Time's. Since 1976, the company that publishes such newspapers as the *Miami Herald*, the *Philadelphia Inquirer*, and the *Detroit Free Press* has sunk about \$50 million into its videotex division, Viewdata Corp. of America. Having started with a British-style system, Knight-Ridder worked with AT&T to design its "Viewtron" service, which is routed to consumers via their telephones. After a trial run in the affluent Miami suburb of Coral Gables, Viewtron was offered to the public in South Florida in 1983.

Viewdata missed its stated goal of signing up 5,000 paying subscribers within a year of its commercial launch by 50 percent. Relatively few people, the company found, wanted to pay \$12.50 per month to Knight-Ridder for a subscription, \$.90 per hour to the local phone company, and \$600 to AT&T for the Sceptre videotex terminal needed to receive the service. As a result, Knight-Ridder lost \$16 million before taxes on Viewtron in 1984.

However, the company did not abandon its new baby. It reduced the staff slightly, offered a package rate for service and equipment rental of \$24.95 per

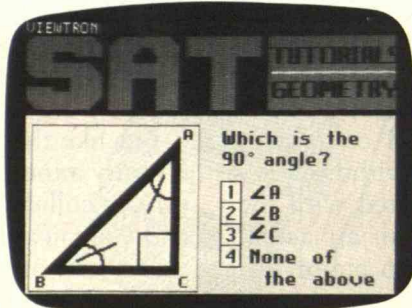
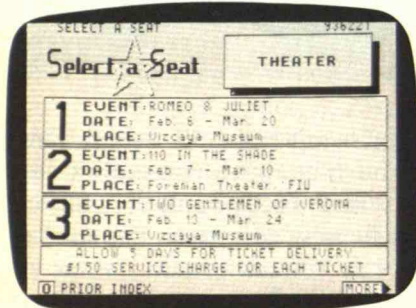
*Phone companies
are already devising the technology for
effectively presenting videotex.*

month—after a sign-up fee of \$45—and began to push its technical staff to find a way to provide access to Viewtron through personal computers.

Their efforts paid off. This year, Viewdata announced that Viewtron can now be routed into IBM, Apple II, and Commodore 64 personal computers. And at the Videotex '85 show in June, Viewtron was displayed over an Apple Macintosh with high-quality graphics. At the same New York show, Viewdata announced that it will soon venture from South Florida to market aggressively in Minneapolis and Charlotte, N.C. And in July, it announced that it was going "national" to owners of Commodore personal

ing closely with the California Agricultural Extension Office, Gateway offers a cornucopia of information on crops, livestock, commodities, weather, and pest control. Significantly, Gateway sold \$1.3 million of national advertising prior to its debut to clients such as American Express, Hallmark Cards, Sears, and J.C. Penney.

Another semi-specialized videotex service will soon be launched by the Trintex joint venture, which consists of IBM, CBS, and Sears Roebuck. Financial services will most likely drive this network, which can take advantage of companies in the Sears Financial Network such as Dean Witter Investments,



computers, who will be able to purchase software for \$9.95 to retrieve Viewtron via Uninet and Telenet discount long-distance phone services. These services will cost \$12 per hour during peak times and \$6 per hour after 6 P.M.

The service is still geared to the home consumer. Screens feature many colors, and the content includes news from several wire services, auctions of products ranging from golf balls to yachts, lessons in Spanish and Scholastic Aptitude Tests, weather bulletins, stock-market quotations, home banking services, airline schedules, and hundreds of special subjects. But the move to personal computers may limit the technology's expansion. For while almost everyone owns at least one color television set, only about 18 percent of American homes have personal computers—and most of those computers are not equipped with the modems necessary to receive videotex services.

A newer videotex system also offers a business angle. Launched on the West Coast in October 1984, Gateway service stems from a joint venture between the Times-Mirror Co., which owns the *Los Angeles Times*, other newspapers, and several magazines, and Infomart, a Canadian videotex company. Work-

Coldwell Banker Real Estate, and Allstate Insurance. Trintex may well offer its first services in public-access videotex (PAV) terminals located in public places such as Sears stores, shopping malls, and hotels. Many observers see PAV kiosks, which will feature touch-screen TVs or easy-to-use keyboards, as ideal vehicles for familiarizing the general public with the concept of receiving printed information through a TV set.

So far, however, the only U.S. videotex service that can be called a success has relatively little to offer the general public. By mid-June the Dow-Jones News Retrieval, with detailed stock-market information and corporate news of interest to active investors, boasted almost 200,000 subscribers. These people pay prime-time rates of \$1.20 per minute to gain access to information from more than 30 database services. The service is not only profitable; it reportedly accounts for almost 10 percent of Dow-Jones' annual revenue.

Costly Lessons

Videotex's troubled first decade in the U.S. has taught the industry several costly lessons. Among them:

*If videotex
did not exist, we would have to
invent it all over again.*

□ It is virtually impossible to create popular demand for an expensive new product that is available in only a few localities. Residents of greater Miami, who were the only potential customers for Viewtron last year, saw no national publicity or advertising about videotex because other cities did not have it. Advertisers are also reluctant to subsidize the costs of videotex until it can claim a large audience.

□ While Americans will pay a small sum each month for an entertainment service such as cable TV, and a large sum for innovative entertainment equipment such as videocassette recorders, they are more cautious about plunging money into revolu-

antly packaged financial databases, home banking, and some form of electronic mail. New services will be introduced as the need for them is perceived—at extra cost, much as cable now offers premium channels. The industry will try to reach this small but affluent audience through business terminals and home personal computers rather than through specialized terminals attached to the living room TV set. The hope is that such subscribers will become disciples of videotex, generating an awareness of the new medium that will greatly increase mass interest in it.

The success of the French telephone service in set-



tionary information technologies. Videotex's natural competitor as a popular medium is the daily newspaper; until it costs about the same as a newspaper, or less, on a monthly basis, the new technology is unlikely to achieve real popularity among the mass audience.

□ The cost of terminals is a key to popularizing videotex. The cost has remained high in the United States because companies insist on providing all the bells and whistles, including sophisticated color graphics. The French kept the technology simple, eliminated the color, and produced an inexpensive terminal. In fact, the U.S. industry's turn to personal computers for home receipt of videotex is essentially a defeat for the original idea that it can be truly a mass medium.

□ The telephone line is the only reliable means of delivering videotex. Cable delivery involves complex technology, is susceptible to bad weather, and would be limited to the less than 1 percent of American homes wired for two-way cable.

Despite these cautions, it seems likely that the re-trenched U.S. videotex industry will aim its services at businesses and affluent homeowners over the next few years. It will offer easily accessible and pleas-

ting up a videotex service should influence the U.S. industry. A logical step is for a major videotex company to create a partnership with a regional phone company such as Bell South or NYNEX Corp., with the videotex operator providing the database and the phone company responsible for the home equipment. An American Minitel would provide telephone subscribers with an electronic phone book, Yellow Pages, and the hundreds of services companies such as Viewdata have already developed.

If they are not offered this type of partnership, the telephone companies will eventually go it alone, providing a service similar to the one now being delivered by their French counterpart. In fact, phone companies are already devising the technology for effectively presenting videotex.

Pacific Bell, for example, recently announced a new multiplexing process that divides a standard, voice-grade phone line into seven separate channels, some for voice and others for data. This will eliminate the problem of videotex's tying up the family phone line. Impressively, one of the data channels will have a transmission rate 32 times that used by most home computer telephone hookups today. Quicker transmission times for graphics and text

*Major news stories
of the future will appear on videotex rather
than in the newspapers.*

should mean lower costs for using the phone lines. Another way of reducing costs is to allow access to videotex services through Telenet or Uninet phone numbers. Viewdata is already following this route.

An inexpensive terminal and low telephone charges will bring the United States into the era of videotex. Then a vast range of information will be available at the touch of a few keys within seconds in a individual's own home. When this happens—and the French experience clearly predicts the future—the telephone companies will be the big winners, along with videotex companies that have pioneered and persevered.

Entering a New Era

What will the videotex era be like? Just imagine the advantages of having immediate access to books, magazines, major newspapers, and reference works from any library or publishing house in the world. Children will be able to retrieve a few pages from a continually updated encyclopedia, with their parents paying royalty costs only on those pages selected. It will be possible to read—and pay for—just the first 10 pages of a sorry novel; the author might still come out ahead, because thousands more people might want to “test-read” the novel than would buy the printed version. Videotex subscribers will also be able to buy stocks, send messages home, make plane reservations, and receive simple medical diagnoses.

How seriously will the growth of videotex affect other media? History suggests that each new medium carves out its own niche while at the same time changing—but not replacing—older media. Radio, for example, eliminated the newspaper “extra.” Television largely eliminated radio news commentary.

The medium subject to the greatest change in this new era will be the newspaper. Videotex will quickly skim off classified advertising; people seek out such ads by category—the basic principle on which videotex is constructed. By simply punching up the keyword “Oldsmobile,” a subscriber will be able to view all the Oldsmobiles for sale in a given city on a given day. Videotex operators will be able to insert a classified ad within minutes of receiving it, and remove it from the system within minutes of the item's sale. And since the service's cost is minimal in the absence of paper, ink, press operators, and delivery people, videotex classified-ad rates are likely to be extremely low.

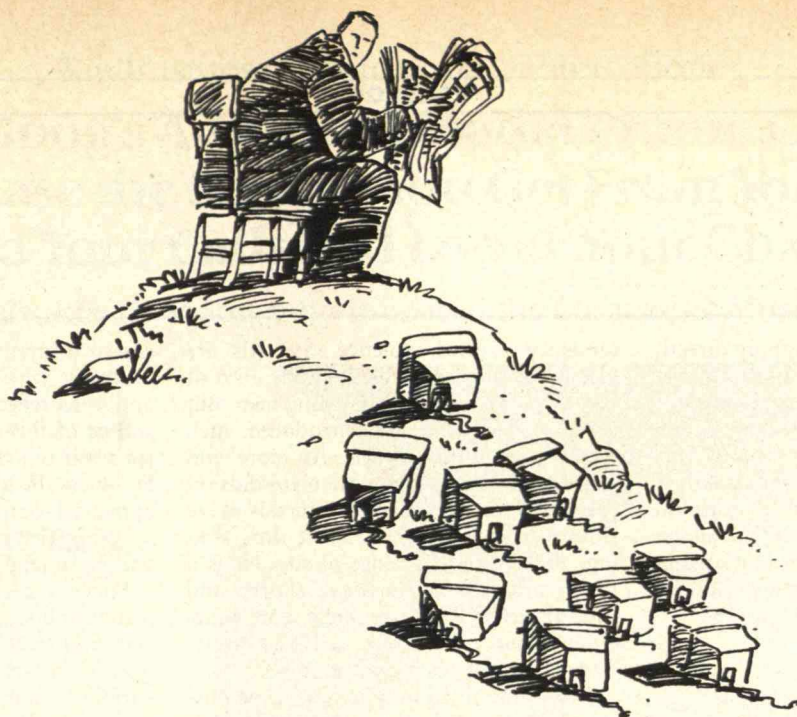
Major news stories in the future will also appear on videotex rather than in the newspapers, because the former will contain full details as they happen. A reporter on scene will type the story into a personal computer and transmit it by telephone link to the main computer. A videotex editor will extract the story, categorize it, and put it—with all the details included—into the system.

Subscribers will read the story because they have sought out its category rather than tripping over it as they do with today's newspapers. After passing the attractively colored headline page, they will be able to read page after page of black and white copy, stopping at any point. Thus videotex subscribers will become their own editors, unhampered by editorial staffs who select what they think might appeal to subscribers. And since database storage is virtually unlimited, the videotex service will contain hundreds more stories than today's typical newspaper can carry. Subscribers will receive all the news that's fit to transmit.

This will definitely change news as a product in the United States. As competition for space is eliminated, there will be room for the ordinary alongside the exciting, the violent, and the highly unusual. Videotex will also allow more room for letters and columns by local citizens, as well as columns by syndicated commentators of every political stripe.

We do not see this as a threat to local newspapers, because it is quite likely that they will either own part of the local videotex franchise or provide the local-news database. Even if they don't, they will still produce a kind of “soft” daily newspaper containing more features and less hard news. Indeed, newspapers have already become appreciably softer over the past 20 years in response to competition from TV news. Soft papers will be supported by the kind of local display advertising that videotex cannot accommodate because such advertisers expect their copy to be placed next to editorial content.

Newspapers might change physically as well as philosophically. Futurists are talking about a “flat-panel” terminal. Consisting of a screen about the size and thickness of a magazine, a flat-panel terminal could be attached to a videotex outlet and have its memory loaded with, say, the *New York Times*. It could then be carried to another part of the house or dropped into a briefcase, for reading at leisure. This would correct a major disadvantage of videotex: its lack of portability.



Legal and social questions will arise when videotex becomes a popular medium. The Federal Communications Commission has indicated that access to and control of teletext are not subject to the Fairness Doctrine and Equal Time Rule that constrain other broadcasters. Presumably the FCC will apply a similar hands-off policy to videotex, treating it as unregulated print media despite its transmission over regulated phone lines. This will enhance the democratic process, because the strength of any newspaper lies in its ability to deliver opinion. Any regulation that would chill this function in videotex, making it subject to the whims of a local, state, or national regulatory body, would diminish democracy in America.

It is, however, possible that videotex will wrap subscribers in a cocoon, permitting them to select only the political information and opinions that reinforce their own views while excluding all others. The cocoon effect is inherent in any specialized medium. Cable TV allows people who so desire to watch sports to the exclusion of news. The many radio frequencies allow listeners to tune in to classical music to the exclusion of rock.

Admittedly, there is a difference between a cultural and a political cocoon. Choosing a cultural cocoon might simply make a person dull. Political cocoons might tend to polarize society, making some segments insensitive to the views of others. However, the variety of opinions available might compensate for this danger.

It remains to be seen whether one should point with alarm to the possibility that news and opinion will become concentrated in the hands of a few megacompanies. The large videotex companies will probably go to many sources for news and opinion—perhaps even offering a variety of local and national newspapers to subscribers. In any case, videotex

companies that do not act responsibly in disseminating a variety of news and opinions could ultimately face government regulation, since they must operate via a common carrier.

Society will have to consider ways of dealing with the inequities of a pay-as-you-read medium. Rich kids, for example, will have access to more reference sources than poor kids. The information gap that so worries communications theorists will likely widen in the first stages of videotex development. However, that can be offset by widespread access to videotex in libraries or PAV terminals. Public agencies might well give an allowance or information credit to disadvantaged families for videotex subscriptions, just as government today offers free breakfasts for disadvantaged schoolchildren.

The advantage of a system that can bring a world of knowledge into every home or business puts the apparent disadvantages into a shadow. A truly free society—as opposed to an authoritarian one—depends on the availability to the average citizen of a wide variety of news and political information. This will be the case in the videotex era as never before.

Many people in the traditional print-on-paper media continue to be skeptical about the viability of videotex. Yet the large companies that continue to invest millions of dollars in it despite their first disappointments recognize that videotex is a medium whose time will come. The reality of videotex in America awaits only an inexpensive terminal, cheaper charges for phone lines, and greater public awareness of videotex's many advantages.

RALPH L. LOWENSTEIN has been dean of the University of Florida College of Journalism and Communications since 1976. A former newspaper reporter and press critic for the CBS Morning News, he has written about and taught courses in videotex and new communications technologies for the past 15 years. HELEN E. ALLER has been director of the College's Electronic Text Center since its inception in 1981. She teaches two courses in videotex that she has developed.

Pharmacia sent a monthly supply directly to my house! Obviously, a bogus prescription was all that was needed to obtain a regular supply of this supposedly scarce and precious hormone. I reported my findings at the 1984 meeting of the American College of Sports Medicine and to the FDA. Since hGH extract is still available on the black market, I doubt that anyone took strong measures to tighten controls over its release.

Other Athletic Abuses

The abuse of drugs by sports stars is not without precedent. The athletic community is still reeling from the misuse of anabolic steroids—synthetic analogs of testosterone, the male hormone—by athletes in all sports at all competitive levels. Doctors now know that the unregulated self-use of steroids to increase muscle mass in training can cause personality changes, including increased aggressiveness and a

tendency toward violence. Steroids are also addicting and heighten the risk of heart attacks in relatively young men. But when steroids were first introduced, such effects were little known. As more and more athletes began to obtain steroids on the black market, sports officials were slow to respond with accurate drug testing. Today the illegal use of steroids is a major problem in American sports, and officials are trying desperately, and somewhat unsuccessfully, to curb this abuse with expensive testing programs.

Are we destined to make the same mistake with hGH? At this point, it looks as if we are. The FDA is under considerable pressure to allow Genentech to market its new synthesized product, because distribution of natural hGH extract has recently been halted owing to some disturbing reports. It seems that three young men have died from a rare, slow viral disease years after being treated with extracted hGH prepared by the NHPP. Creutzfeldt-Jacob dis-

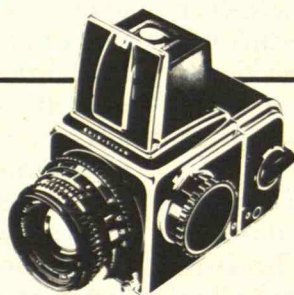
ease is a mysterious viral infection of the brain for which there is no known cure, and researchers are concerned that the source of this infection was the hGH extracted from the brains of dead donors. So unless the artificial growth hormone is approved soon, treatment for an estimated 3,500 patients with pituitary disorders will be in jeopardy.

Furthermore, clinical research is also being conducted on the use of hGH to prevent and treat heart disorders and osteoporosis (a lack of calcium in the bones), various metabolic disorders, and burns and bone fractures. It has even been mentioned as a possible anti-aging hormone.

The FDA should approve this synthetic hormone—but as a controlled substance, not a general prescription drug. Almost no one keeps accurate records on the release of general prescription drugs. They may be dispensed via drug companies or pharmacies by physicians or people acting under physicians' orders. Once the FDA approves a substance as a general prescription drug, doctors may choose to use it for purposes other than those approved by the FDA. Just because a product is intended only for prescription use does not prevent it from being widely misused.

Classifying synthetic hGH as a controlled substance would require accurate record keeping whenever the drug is dispensed. The whereabouts of every vial or pill of the synthetic hormone would be known. Furthermore, orders for any controlled substances from drug companies or licensed physicians and scientists must carry numbers from the Drug Enforcement Agency. As a result, prescriptions can be more easily traced. Also, the penalties for violating the laws pertaining to controlled substances are stiff enough to effectively deter black marketeers.

Given the millions of research dollars spent to genetically engineer hGH, however, it seems certain that Genentech and Eli Lilly (which have a joint arrangement to market hGH) are counting on expanding the clinical uses of synthetic hGH. There's no question that hGH has enormous promise as a therapeutic drug for a variety of conditions. However, because of the potential for its abuse by athletes, experimentation with this substance should be allowed only in federally approved laboratories by qualified physicians and scientists. As further medical uses for hGH become evident, the FDA could reevaluate its highly controlled status. □



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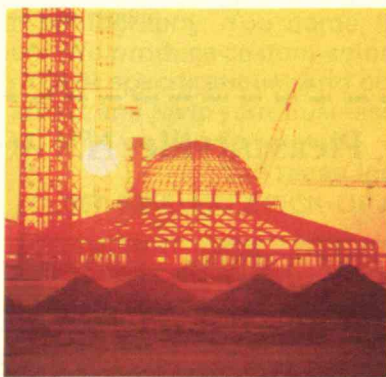
BY FRED MOAVENZADEH

THE current economic debate has focused on troubled manufacturers and the boom in service work, but rarely does anyone mention the construction industry. It has no General Motors; it is composed of some 1,200,000 firms, 720,000 so small they have no payrolls. Most of these firms are local and use no mass production. They work seasonally and change chameleon-like in response to demand. For a given project, an ad hoc team may assemble consisting of workers, contractors, designers, developers, investors, suppliers, and representatives of any of 70 labor organizations and countless regulatory agencies. When the job is done, the crew disbands.

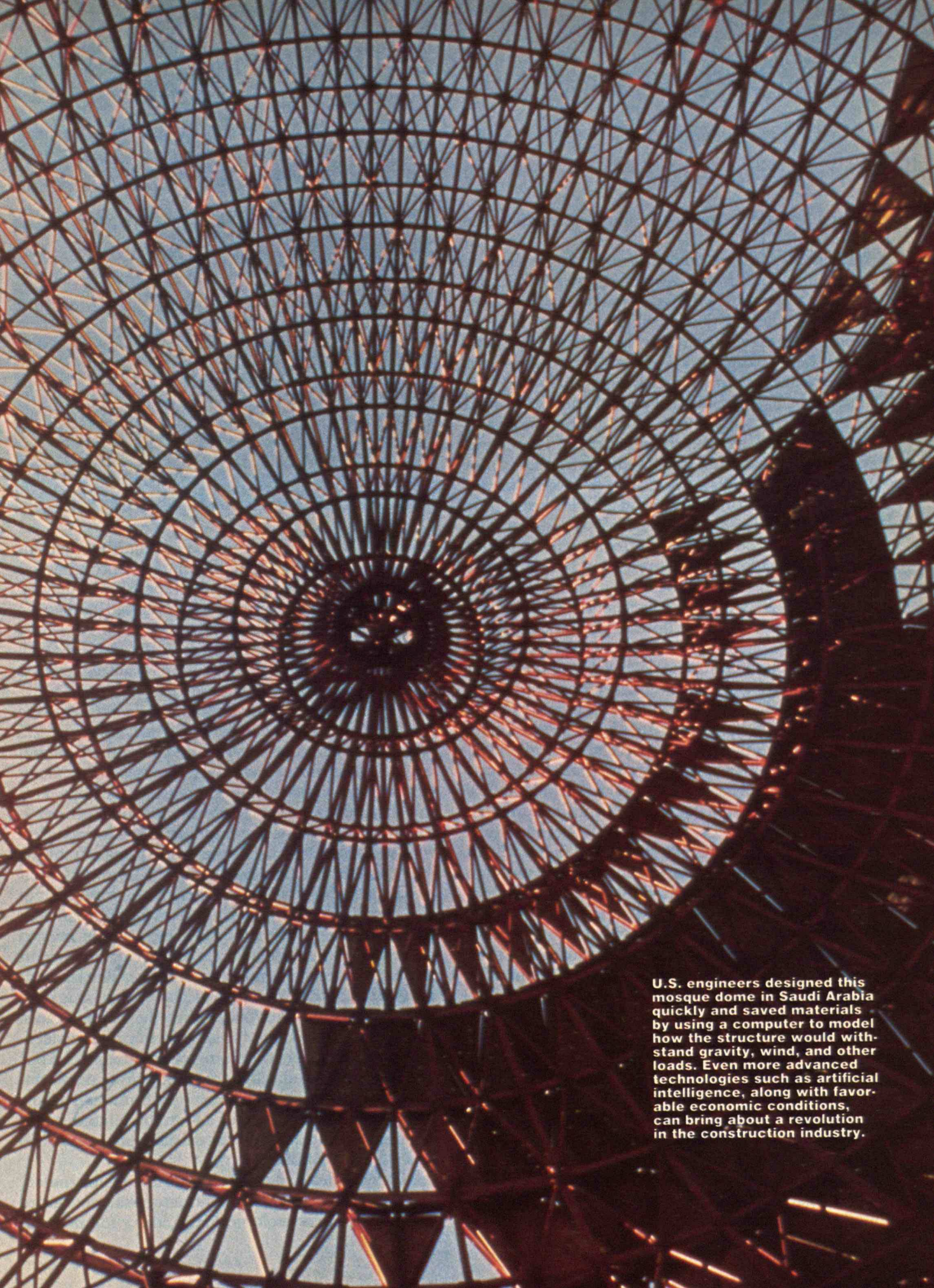
Yet construction is America's largest

industry. It performs more than \$300 billion of work each year and employs 5.5 million workers. Add to these the suppliers of materials, machinery, insurance, designs, and blueprints, and construction accounts for 17 percent of the work force. Construction has traditionally comprised some 55 to 65 percent of the nation's capital investment, helping to make the United States the greatest industrial producer on earth. The industry affects the lives of everyone as it builds and repairs homes and 100-story towers, septic tanks and billion-dollar sewage-treatment

plants. U.S. contractors also go abroad, building industrial complexes in Jubail and Yambu in Saudi Arabia, nuclear plants in Latin America and



PHOTOS: BECHTEL



U.S. engineers designed this mosque dome in Saudi Arabia quickly and saved materials by using a computer to model how the structure would withstand gravity, wind, and other loads. Even more advanced technologies such as artificial intelligence, along with favorable economic conditions, can bring about a revolution in the construction industry.

Europe, and petrochemical complexes around the world.

However, the U.S. construction industry has recently found itself in the doldrums. Since 1975, construction's share of the gross national product (GNP) has been only 6 to 8 percent, down from 9 to 12 percent in previous years. By comparison, Canada and Sweden devote 16 percent of their GNP to construction, and Japan devotes 20 percent.

Given the large amount of capital equipment used in construction, output per hour of labor should be great. However, the U.S. Department of Commerce index on this output has been disheartening. From a high of 130 in 1972, the index fell to almost 90 in 1982. The cost of construction has also been rising faster than inflation since the mid-sixties—another sign of poor productivity. "By common consensus and every available measure," the U.S. Business Roundtable has stated, "the United States no longer gets its money's worth in construction."

Problems have shown up abroad as well. With recession and high interest rates, the value of overseas construction contracts dropped in the late seventies and early eighties. But even within that shrinking market, the U.S. share decreased. Of the total work done by the top 250 firms in the world, the U.S. share fell from 46 percent in 1980 to 31 percent in 1983, according to *Engineering News Record*. (Figures for 1984 are not yet available.)

At the same time, many foreign firms have entered the U.S. market. In 1979, when bids were let for a new sewage tunnel in San Francisco, Ohbayashi-Gumi of Tokyo won the job. Some large foreign construction firms, such as Boneh International of Haifa, Israel, have begun to bid directly on U.S. projects, while others have purchased or formed joint ventures with domestic firms that already know their way through American codes and regulations. For instance, Philipp Holzmann AG, based in West Germany, bought J.A. Jones Construction Co. of Charlotte, N.C.

What Is Wrong?

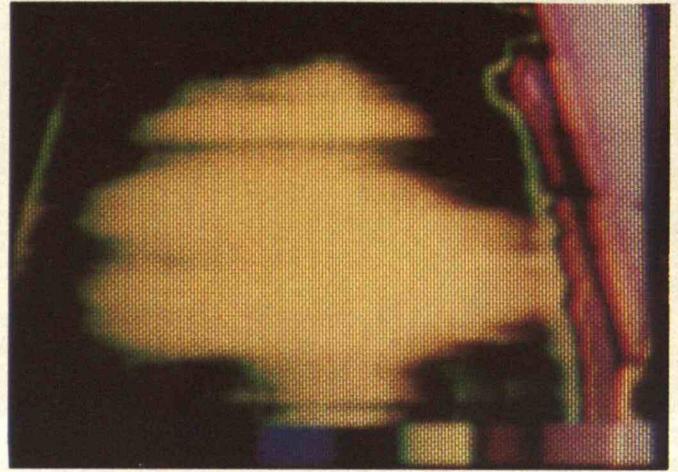
Through the sixties U.S. construction advanced at a rapid pace and was far ahead of its foreign competitors. Thus, the industry saw little reason for concern about its technological edge, and soon other issues began to gain its attention. During the seventies the industry had to learn to cope with envi-

ronmental impact statements, building restrictions in historic districts, and requirements for community participation in major projects. These and other recent government regulations, however necessary, caused delays and added to costs. A single coal-fired power plant now may require 60 to 100 federal, state, and local permits and more than eight years for licensing, engineering, and construction.

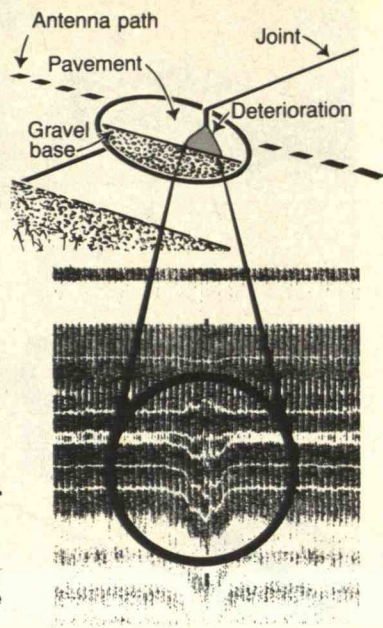
The industry also points to union strikes as a source of disruption. Since they affect only one job site, construction strikes do not make the national news the way strikes by autoworkers do. But members of some 30-odd unions may be working at a job site, and a strike by even one can halt a project—say if the carpenters stop building forms for concrete foundations. Such strikes increased markedly in the late sixties and seventies.

The industry also complains that tax and regulatory policies inhibit U.S. construction abroad. For citizens of many other countries, income earned away from home is tax-free. Americans, however, must pay taxes on their foreign income, which means that U.S. contractors have to pay higher wages to U.S. workers abroad. Also, unlike the United States, many governments use foreign aid to provide incentives for giving construction work to their domestic firms. In one case, a Japanese company won a contract for a bridge over the Bosphorus Strait in Turkey, apparently with the help of a loan the Japanese government gave to Turkey. (The British are taking this issue to international court.)

Many of these tax and regulatory problems are genuine. However, if U.S. contractors had continued to maintain a technological lead, their competitive-



Government agencies responsible for highways and bridges are short on inspectors. Some devices are now available to speed and improve inspections. Van (upper left) carries an infrared camera and radar to examine the pavement. Lighter areas in the infrared image (lower left) indicate possible separation between layers of pavement. Radar chart (right) indicates possible deterioration in the joint between two sections of paving.



Artificial-intelligence systems may soon be able to interpret the read-outs of remote sensors. Such systems could determine inexpensively and effectively whether a bridge, sewer, or offshore structure needs repair.

ness could not be so easily challenged, and external factors would not be so important. The industry itself now realizes this. A manager of Bechtel, the California-based construction company, admits that American contractors have been "rapidly losing the technological edge" they had ten years ago.

Ohbayashi won the sewer contract in San Francisco because of its advanced tunneling technology. When a tunnel is dug through soft earth, as in San Francisco, it must be maintained at a few atmospheres of pressure to keep it from caving in. Workers must spend several hours in a pressure chamber before entering the tunnel and several more in decompression afterwards. They can stay inside for only three or four hours, always at considerable risk from cave-ins and asphyxiation. Ohbayashi used the new Japanese "earth-pressure-balance" method, which eliminates these problems. Whirling blades advance slowly, cutting the tunnel. The loose earth temporarily remains behind to balance the pressure of the compact earth on all sides. Meanwhile, prefabricated concrete segments are inserted and joined with waterproof seals to line the tunnel. Then the loose earth is conveyed away.

This new tunneling method enabled Ohbayashi to bid \$5 million below the engineer's estimate. And in an almost unheard-of feat, the firm completed the tunnel three months ahead of schedule.

A Construction Revolution

Today an extraordinary confluence of new technologies and a large and stable market for construction can bring about a revolution in the U.S. industry.

The decay of the U.S. infrastructure—highways, mass-transit systems, ports, water mains, sewers, and other public works—will provide a market for new construction. Computers, robotics, and advanced materials stand ready to be used, especially in labor-intensive repair and maintenance.

A similar situation existed early in this century, when horses hauled dirt, drew plows, and lifted pulleys to build highways. Then as now, technology stood ready to be applied. Engineers had already produced steam and internal-combustion engines and had the basic industrial know-how to develop the steam shovel, bulldozer, and power grader. But they did not do so until the federal government provided a market for these new machines by financing a national road system.

The first step was the Federal Highway Act of 1916, ending the era when roads were built haphazardly by state and local governments and by private enterprises that charged tolls. A succession of laws promoted the federal system, culminating in the 1956 Highway Trust Fund that was set up to finance the interstates.

The market for highway construction had two key features. First, it was large and stable: contractors could depend on a continuing demand for improved technology. Second, it was not monopolistic: the contractor with superior technology was likely to win the bid. These conditions sparked amazing productivity gains in construction that continued for 50 years.

Machines did not simply replace workers. Rather, contractors learned to build highways with less labor *and* less capital. For example, the number of workers needed to excavate and haul dirt 100 meters fell 90 percent from the twenties to the fifties, and another 5 percent from the fifties to the seventies. The capital investment needed for this same operation fell more than 30 percent from the twenties to the fifties, and another 20 percent from the fifties to the seventies. Diesel shovels perform work more cheaply than steam shovels, and steam shovels more cheaply than horses.

Such advances helped keep a lid on highway costs from the twenties through the mid-sixties. According to the Federal Highway Administration (FHWA) index, a length of highway that cost \$100 to build in 1925 would have cost \$460 in 1967, if inflation had been the only variable. But because of improved technology, the cost in fact rose to only about \$200.

Workers' earnings rose by 340 percent, but because of increased productivity, labor became a smaller part of total construction cost.

An Opportunity

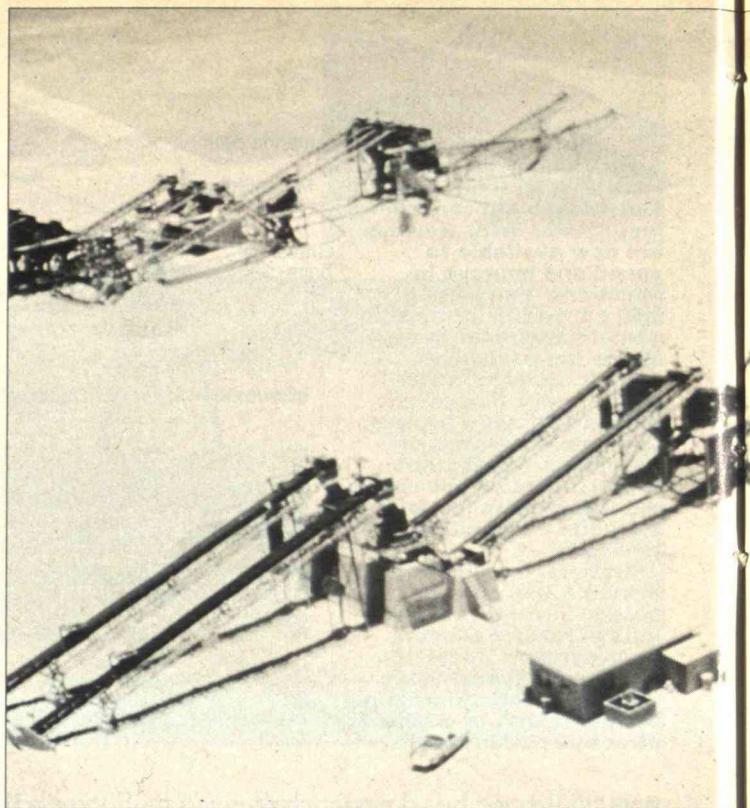
Like building the interstate system, repairing the infrastructure should provide a large, stable market for construction. Current estimates are that this repair will cost \$1 trillion to \$3 trillion over the next 20 years. These estimates may be exaggerated, but even so there are plenty of cratered roads, weakened bridges, and polluted waterways to keep construction firms busy.

The Department of Commerce estimates that nearly half of all U.S. communities can no longer support economic growth because their sewage treatment plants are operating at or near capacity. Nor do most regions have facilities to treat toxic wastes that industries produce—2,600 pounds per person each year. The United States has 189 commercial ports that handle \$450 billion in trade each year, yet only \$66 million a year is spent to maintain and repair them, and many are in bad shape. Facilities in Baltimore are so inadequate that ships must sometimes queue up for weeks to unload. In extreme cases, decay poses a safety threat: more than a third of the 8,800 high-risk, non-federal dams in this country are in danger of breaking. A single dam break in West Virginia in 1972 killed 125 people and destroyed millions of dollars worth of property.

Government officials and voters are becoming aware of these problems, and in the past few years have begun to allocate more money to rebuild the infrastructure. According to the Department of Commerce, annual investment in public construction declined from \$46 billion in 1972 to \$33 billion in 1983, but rose to \$36 billion in 1984. The figure should increase to \$37 billion this year. (All figures are in 1977 dollars.)

Some of this money comes from new taxes. The Surface Transportation Assistance Act of 1982, which raised taxes on gasoline by a nickel a gallon, is expected to produce \$5.5 billion a year. With their shares of the revenue, plus tax increases of their own, many states are letting more highway contracts. Missouri, a typical state, awarded \$16 million in highway construction in January 1982, before the federal bill was passed, and \$40 million in January 1983.

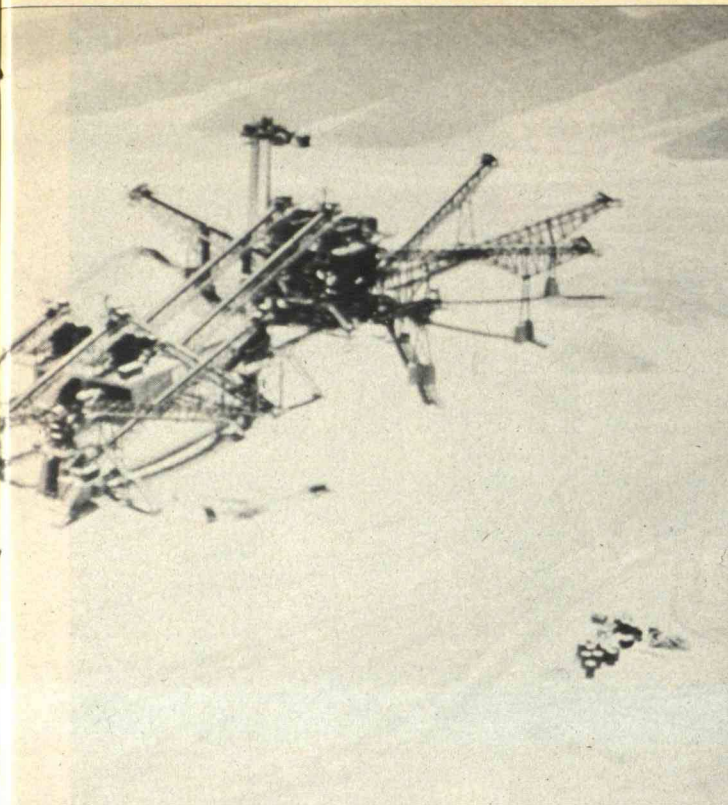
States and cities are also devising new ways to



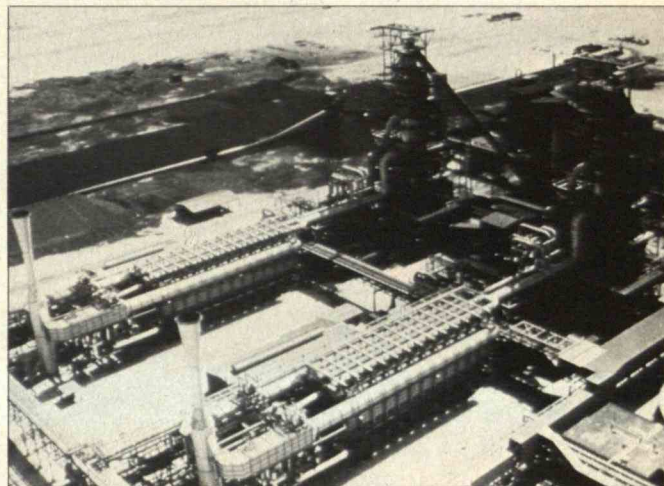
finance public construction. "Privatization" is spreading to many communities. In Scottsdale, Ariz., a private firm called the Scottsdale Water Service Co. is building a water treatment plant. Water fees will pay for the investment and operating expenses. Massachusetts Governor Michael Dukakis has proposed revising business taxes—for example, reducing the credit allowed for investments—to produce revenue for infrastructure repair. On November 8, 1983, U.S. voters approved 9 out of 10 dollars in tax-exempt bond issues proposed on ballots. This money, \$2.88 billion in all, will largely be used to finance public works.

The construction industry itself is less troubled now than a decade ago and better able to face new challenges. For one thing, it has learned to live with regulations enacted during the seventies; projects once stopped dead by environmental and community opposition are being revived. A third tunnel under the Boston harbor, in planning since 1968, originally met with opposition. Construction would have torn up large parts of East Boston. But planners have now moved the tunnel entrance to a corner of the airport itself, and opposition has subsided.

Labor problems have also abated. Contractors have sought to reduce labor costs by hiring from "open shops"—that is, from outside the union hiring hall that traditionally assigned workers to jobs. The open shop has not led to the defeat of organized labor, but unions are modifying demands to stay competitive. Labor and management have learned to bargain.



U.S. construction is a major export industry. In Saudi Arabia American firms are building a \$3.2 billion airport near Riyadh (left) and much of a 360-square-mile industrial complex in Jubail (below). The complex is expected to have 250,000 residents, 19 primary industries such as steel and chemical plants, and some 200 light manufacturing facilities.



Applying Technology

While the construction industry is ready for new technologies, they are ready for commercial use—especially in labor-intensive maintenance and repair. Materials account for a relatively small part of the cost of such work, but they must fill potholes, cling to old structures, and resist stresses in unusual ways. Thus, a superior material may be economical even if expensive per pound. Firms often have to do repair and maintenance jobs in inaccessible locations (sewer pipes), in dangerous places (toxic-waste dumps), and at inconvenient times (between one and five in the morning). Even if remote-control and robotic devices are expensive to develop, they may pay for themselves many times over.

Computer technologies will contribute in important ways to construction. Today knowledge-based systems (or expert systems)—computer programs that draw inferences from a body of information and “learn” from experience—can help drill for oil, fight forest fires, and diagnose patients. This technology could easily aid construction, too.

Some of the industry’s greatest problems lie in assessing the condition of old structures. Most agencies responsible for the infrastructure are short on inspectors. After the Mianus Bridge in Connecticut collapsed, investigations revealed that on average only four hours of inspection are possible every two years for each bridge in the state highway system. And then there’s the problem of limited methods. Inspectors can look at a bridge, but that is difficult

to do underneath it or underwater. They can strike a bridge deck with a hammer to determine, from the sound of the ping, if layers of concrete have become delaminated, but that is time consuming. Other forms of deterioration are still impossible to assess.

Faster and more reliable inspection techniques are becoming available. One, infrared thermography, measures the surface temperature of concrete to find delamination. Since delaminated areas are thinner than others, they become warmer on a sunny day. Inspectors used a van equipped with an infrared thermography device to evaluate the Dan Ryan Expressway Viaduct in Chicago. In Springfield, Ill., and other cities, inspectors have used ground-penetrating radar to plot pavement voids, joint deterioration, and other conditions.

However, interpreting the readout of sensors requires several kinds of expertise. One expert might look at the complex wave patterns of a radar readout to discover a void in a concrete bridge. But telling whether the void is a normal condition or a sign of deterioration requires a civil engineer’s knowledge of how a bridge is constructed and a material specialist’s knowledge of how concrete deteriorates. Gathering and interpreting all the necessary information would be expensive and time consuming.

This is where the value of knowledge-based systems comes in. Kenneth Maser of M.I.T. is working on one that might use a vehicle equipped with radar and computing equipment. The vehicle could cross a bridge along with other traffic and automatically assess the condition of the deck.



Just as a doctor often requires many tests to make a diagnosis, inspectors often require several readouts to assess a structure. Maser has suggested that maintenance crews could tow suites of sensors at highway speeds to survey a road. A knowledge-based system could correlate all the readouts to determine the condition of the road. Different knowledge-based systems, with data from different suites of sensors, could assess other structures, such as sewers and offshore platforms.

Of course, U.S. firms already use computer-aided design (CAD), which has helped them win Mideast design contracts. By using it to test alternative designs of complex structures such as petrochemical plants, U.S. engineers were able to do a better job than their competitors—and at a lower cost, competitors' subsidies and tax breaks notwithstanding.

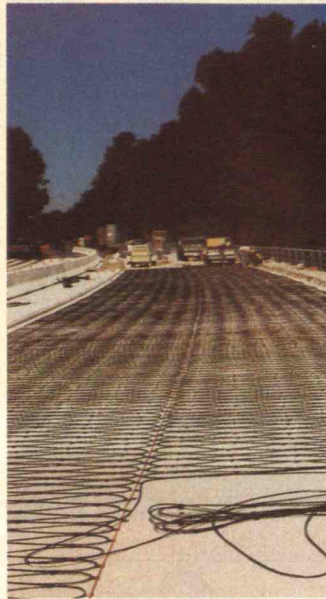
Knowledge-based systems may provide further advances in design. Engineers never have all the information they would like. Those who design bridges always want to know more about the soil, future traffic, possible effects of an earthquake, and so on. Should the primary structure be suspension cables or girders? How many pilings should be sunk? What design will best adapt to future conditions? A few basic decisions may have broad ramifications, and a knowledge-based design system could give engineers creative perspectives on those ramifications. It might suggest new approaches, like those structural engineers devised when they discovered the advantages

of building certain high rises as tubes rather than frames. And work has begun on knowledge-based systems for design. Mary Lou Maher of Carnegie-Mellon University has developed one called HI-RISE, which presents alternative schemes for the structure of high rises.

With today's high interest rates on construction loans, avoiding even a small delay on large jobs can save thousands of dollars. Contractors already use personal computers to schedule and monitor the work of scores of subcontractors, inspections by regulatory agencies, and deliveries by suppliers. Leston Nay and Robert Logcher of M.I.T. have proposed a knowledge-based system that would make schedules easier to maintain and monitoring more effective by predicting how jobs are likely to fall behind. The system might forecast the fact that rocky ground will tax a power shovel, and recommend servicing the equipment more frequently than usual.

Robotics and Remote Control

Like the steam engine, computer-based automation will arrive at the construction site after it has become incorporated in the factory. Whereas a robot in an automobile factory spray-paints identical car bodies, a robot on a construction site will have to adapt to many configurations of walls, doors, and moldings. It will also have to withstand heat in summer, cold in winter, and mud year-round.



New technologies can preserve existing structures. In 1984 an old garage in Minneapolis collapsed (far left). Decades of de-icing salt had rusted the reinforcing steel.

A method called "cathodic protection" can stop this deterioration: Rusting occurs when negatively charged chloride ions in salt water react with steel. In cathodic protection a negative current directed into the reinforcing bars repels the chloride and prevents rust.

Left top and bottom: a mesh is installed on the Cabin John Bridge in Maryland to deliver the electric current for cathodic protection. Above: concrete is laid over the mesh.

But even if robots are not yet practical for many construction jobs, they could soon be useful in some situations. One is repairing inaccessible structures such as pipes and sewers. Remote-control devices are already being used to do this. Hamilton Township, N.J., has used a typical system to repair many of its sewers, some dating back to 1914. In this system, a remote-controlled television camera and a remote-controlled cylindrical sealing device are moved through a sewer. Watching the image from the camera, a maintenance worker places the sealing device over leaks and makes it inject sealant.

Handling materials is the largest part of construction work. Robots that move supplies and keep an inventory of them would provide great savings. Cranes—perhaps the mechanical ancestors of construction robots—already use microcomputers to manipulate their loads safely and accurately. Someday contractors may also have robots on the site to cut boards, pipes, and panels, rather than sending the specifications out to fabrication plants.

As Gregory Baecher of M.I.T. has suggested, advanced robots could excavate and transport earth. Some contractors already use a laser beam to establish a reference level; by comparing the height of their blades to this level, scrapers automatically cut to the proper depth. In the future, contractors could program trucks to travel a particular circuit, removing earth from a pile at one corner of a site and depositing it elsewhere.

Tunneling provides prime opportunities for robots. The Japanese earth-pressure-balance method for tunneling through soft earth is already highly mechanized. Lasers aim the cutting tool, though an operator controls it. A manipulator arm installs the segments of the tunnel liner. Automation could help contractors tunnel through hard rock. Cutting tools, which break down rapidly, would last far longer if the rock were weakened through heating. Humans would require elaborate shielding from the heat, but robots would be easier to shield, and if the shielding failed, life would not be lost.

The rate of occupational injury and illness is higher in construction than in any other industry—even, for the most part, than in mining. Where the dangers and costs of protecting workers are greatest, robots would make a significant contribution.

Advanced Materials

While there have been important gains in improving conventional building materials such as concrete, an almost entirely new set of materials is emerging, largely from work in aerospace and electronics. Discoveries about the microscopic structures of materials and their properties are enabling engineers to produce useful new compounds.

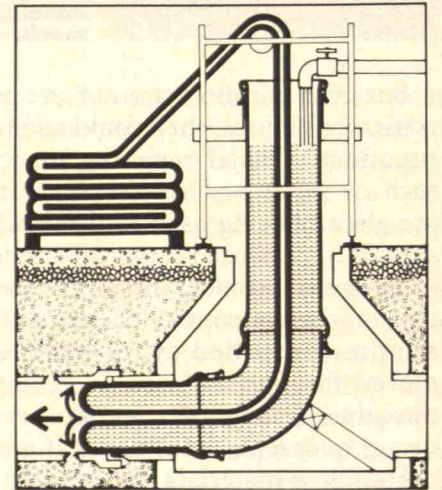
For the past two decades, polymers have gone into concrete to increase its strength, water resistance, and ability to insulate. These polymers have been expensive to use because they have had to occupy as much as 10 percent of the cement. However, Swedish researchers have helped reduce costs by using polymer microspheres 8 millionths of an inch across, which occupy less than 1 percent of the cement. Concretes made with these microspheres meet even the strict standards for offshore structures in the North Sea. Research on microadditives will probably produce useful concretes for repairing roads and bridges as well.

As they learn more, researchers may produce materials with radically different surfaces and interiors. For example, an intense but short-lived burst of radiation from a laser can be used to melt a shallow layer on the surface of a highway. The surface quickly solidifies, locking in microstructures with superior resistance to friction, wear, and corrosion. A similar treatment might improve railroad tracks.

Researchers have been learning how to blend and bake ceramics into materials that are stronger than



Old sewers can be repaired without digging up streets. Diagram: Water pressure forces a pliable felt tube into a sewer from a manhole. The side of the tube against the sewer wall is saturated with a resin that hardens and forms a bond. Photo below: a sewer-lining tube being installed. Left: a sewer before being lined. Below left: afterwards.

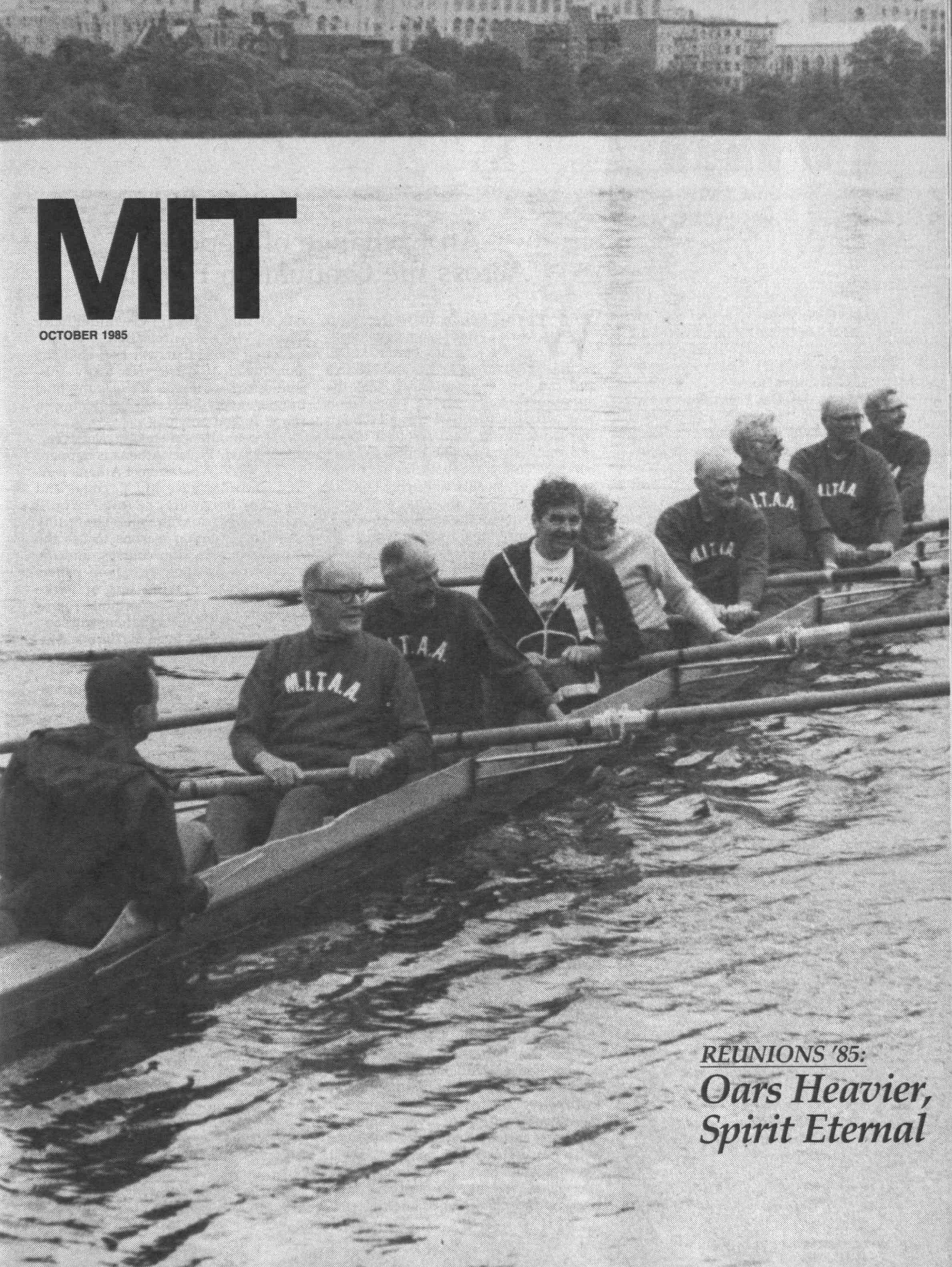


steel, as hard as diamonds, and tough enough to withstand a blast furnace. One key is to ensure a uniform microstructure of particles of the same size. When fired, such particles form ceramics without the microscopic cracks that can lead to breakage.

Backed by the Japanese government, Misawa Home, one of the world's largest home builders, has sponsored research leading to "precastable autoclaved lightweight ceramic" (PALC)—a ceramic fired with hot, dry steam. PALC has all the advantages of a conventional material such as wood, but it is made from what is available in Japan. Misawa uses wastes from factories as sources for its limestone and silica. Houses built of PALC are several times stronger than their U.S. counterparts, yet no more expensive per square foot.

In the United States, ceramics will find a market in repairing broken concrete, lining pipes, surfacing bridge decks, and making roofing materials. Ceramics made to withstand Arctic cold or desert heat, and toxic chemicals or radioactivity, will be useful even if expensive.

Other technologies such as "cathodic protection" will help preserve materials in existing structures. The salt that de-ices concrete bridges, parking lots, and so on rusts steel reinforcing bars. When they rust, these bars weaken and expand, cracking the concrete. An old garage in Minneapolis collapsed in June 1984, and although the exact cause was hard to determine, decades of salt had clearly rusted the reinforcing steel. Rusting generates a current, much as in a battery. The negatively charged chloride ions



MIT

OCTOBER 1985

REUNIONS '85:

*Oars Heavier,
Spirit Eternal*

An Exchange of Reports Across the Graduation Frontier

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ABOUT THE COVER

The schedule said 10 a.m., June 6, 1985, but in the tradition of crew teams everywhere, these veterans from the Class of '35 were on the water much earlier, undissuaded by the overcast, chilly weather. It was the essence of Reunion: an occasion not only for spurring memories, but for sharing those memories with wives and classmates who understood their value. Photo by Frank Revi, '86.

When I began to write about M.I.T., I spent some time reading back issues of the M.I.T. section of *Technology Review* and *The Tech* and came to the conclusion that the question of whether an M.I.T. education was worthwhile had already been worked to death. So I resolved not to add another voice to the chorus of long-winded complaints about the pace and pressure, the quality of teaching and of life, the malice of the administration, and the apathy of the students. Instead, I would concentrate on identifying, describing, and honoring some of the things that make M.I.T. worthwhile.

I haven't always kept my resolution, but it certainly wasn't for lack of good things to write about. I could spend a lifetime at M.I.T. and be constantly discovering new things. In my final term, I discovered a service group and the M.I.T. Assassins' Guild, I took courses in three departments I'd never taken courses in before, moved to a different dormitory, and met lots of people.

But I am not going to spend a lifetime at M.I.T.; by the time you read this, I and my thousand classmates will be several months into the "real world," as students call the rest of their lives. We will be alumni like you. As seniors, we sought out alumni, hoping they would give us useful advice for dealing with the "real world," much as we once sought out upperclassmen in the hope they would hand us a magic key to M.I.T.

So What Is Happening at M.I.T.?

So what is happening at M.I.T.? one alumnus asked me.

Tuition is going up, I said. People are worried about finding jobs. I, for instance, had few offers, and had moments of seriously doubting the marketability of my M.I.T. degree. "Everyone will be after you. You're a humanist and an engineer, a floor wax and a dessert topping," people said. Yet the companies seem to be hiring mostly specialists, and mostly electrical engineering and computer science special-

ists at that. And they wonder why Course VI is overenrolled.

I don't think that will last, said the alumnus. In the late '60s, early '70s, aero-astro was big. Space was the final frontier; everything was happening in space. It died down.

Still, computers are taking over everything, I said. Project Athena is happening to M.I.T. What Project Athena is, is DEC and IBM gave M.I.T. crates and crates of hardware, saying, "You'll know what to do with this." The faculty are busy inventing reasons to use the Athena computers in courses, and the students are writing their term papers on them and playing lots of video games. There are now terminal rooms all over the Institute, and there will soon be terminal rooms in all the dorms. Athena is going to put beeping terminals in my favorite quiet lounge.

Curriculum reform, I said. Curriculum reform is happening. There is a new provost and he is going to try to make the requirements more manageable. At the same time, though, the Humanities Department is planning to reform the science-writing curriculum in the other direction. They seem to be concerned that science-writing majors don't have the necessary trivial skills they think we need to get jobs. So there is talk of replacing the current plan, where we simply take four courses that consist mostly of writing essays and news stories on topics of our choice, with a baroque system of classes on drawing clear graphs and other mechanical skills.

It's not just the Humanities Department, either, I said. Materials science revised its curriculum when I was a sophomore; we are now required to take six advanced elective courses in materials processing. And three of the six



DIANA BEN-AARON, '85, IS THE ASSOCIATE EDITOR OF DATA DECISIONS, A NEW ZIFF-DAVIS PUBLICATION THAT WILL SOON BE ON THE STANDS.

*"You are a humanist
and an engineer,
a floor wax and a
dessert topping."*



have to be about a particular sort of materials—alloys or ceramics or polymers or electronic materials. "While I am indeed an alumnus . . . in Course III-B (Materials Science Co-operative Course), I have not directly used that training for as much as a day since I graduated," wrote Joseph E. Boling, '64, in response to a recent department alumni survey. Boling is now a lieutenant colonel in the Army, specializing in computer management and foreign-area (Japanese) studies. And the department wants us to declare *subspecialties* as undergraduates?

This worries me. As Huxley said, "Nothing ages so fast as the absolutely up-to-date." A new technology could come along and wipe out my electronic materials processing course tomorrow. Why not teach us more science? Science lasts—at least, it lasts longer. But in the School of Science you see the same phenomenon: math now has a joint degree

with computer science, and physics has an electrical engineering option.

This emphasis on skills may make us more "marketable" now, but I doubt it will help us in the long run. Peter Pouncey, president of Amherst College, speaking of the rise of the humanities at M.I.T., said, "M.I.T. in the 1920s discovered that all of its engineers were, in fact, fantastically well-trained, but that they were never securing the top positions in corporations. In other words, the sheer applicability of what they did was seen to be a block to their taking the central leadership position in management."

I was on an airplane last spring, flying to California for a job interview, and the stewardess noticed my brass rat. "What a pretty ring," she said. "A beaver. Is that from Washington state?" I explained the beaver was nature's engineer. She looked puzzled. "Aren't ants also nature's engineers?" she said.

She was right. The beaver can design and construct on his own; the ant is essentially a nerve cell on legs, useless without the rest of the colony. Yet both are engineers. We are in grave danger of becoming overspecialized, of becoming ants rather than beavers. But the companies seem to want to recruit ants! Instead of assigning us applied basket-weaving courses, the Institute might do something to improve its placement networks.

Finding "the Right" Job

How does one get a job like yours anyway?

You're not going about it the right way, said the alumnus. The kind of jobs you are looking for do not come to the Placement Office looking for M.I.T. students, and they do not get advertised in the want ads either. You have to use your connections, you have to sell yourself, try every possible route.

Are you thinking about graduate school? asked the alumnus.

No, I said. Not now. I've been hanging around M.I.T. for seven years now, and going to school for sixteen. I need a change of scene.

It has been my experience, and that of many people I know, said the alumnus, that for about five years after you graduate, there is not much return on an M.I.T. degree. You come out of there never wanting to see the place again. Plus, you have the impression that M.I.T. degrees are a dime a dozen because everyone you know has one. But five years down the road, you are far enough away to get some perspective on the place, to actually start to like the idea of M.I.T. again. And coincidentally, that is when people start to think your opinion carries more weight because you went there.

Really? I said.

As a matter of fact, I'm beginning to have fantasies of going back there to teach, said the alumnus, as he got up to catch his train. So if you hear of any professorships opening up, please let me know. □

Returning to Cambridge: Reliving Memories, Repaying Debts

Aren't four years at M.I.T.— or eight years, as the case may be—enough? Why come back?

The simple answer is that four years—even eight years—are *not* enough. Alumni discover that the place has seeped into their heads, even their hearts. So they return to relive memories, repay debts, cement friendships—and absorb some new ideas, too.

Most of those things happen whenever alumni come back, whether by ones and twos for personal business, by scores for seminars and committees, or by thousands for Technology Day.

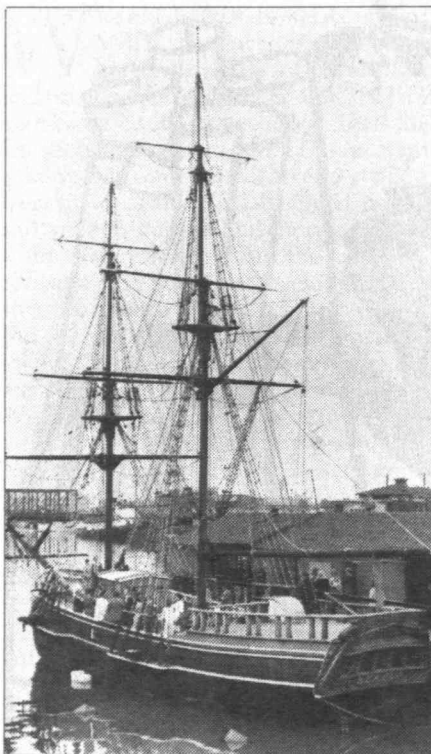
All of them happened last June, when a near-record 2,000 alumni and guests returned to Cambridge for the traditions of Technology Day on June 6 and 7 and the pleasures of reunions on June 8 and 9. They cheerfully renewed friendships right up to the opening bars of music from the Boston Pops Orchestra conducted by John Williams for "Tech Night at the Pops." The next morning, Kresge Auditorium was nearly filled by alumni in search of new ideas in the life sciences—a symposium devoted to contributions by M.I.T. faculty to a field that remains for many alumni unexpected at the Institute (see page A9).

They came from almost every state and from 12 foreign countries. The longest-distance traveller was Ching T. Yang, '30, from Shanghai, the oldest Harold S. Osborne, '08, of Montclair, N.J.

And when it came to repaying debts—well, they did that, too, with grace and generosity.

John Taplin, the Class of 1935 reunion gifts chairman, began by reminding the luncheon audience of over 1,200 alumni and guests that a decade ago his classmates had produced a record 40th reunion gift. Today, he said, they had a different record—at 96 percent, the highest participation ever in a 50-year gift. The total was a near-record \$3,740,000.

The Class of 1945—the smallest that had gone through M.I.T. since 1931, said gift chairman Christopher Boland—



offered a 40th reunion gift of \$1,250,000. To reach that sum, 67 percent of the class had contributed an average of over \$5,000 each.

The real record-smasher came from Barry Bronfin, the Class of 1960's 25th reunion gift chairman: contributions of \$1,960,000, an all-time record 25th reunion gift, from 67 percent of the class—record participation as well. Of the total, said Bronfin, \$346,000 was earmarked for a special Endowment for Innovation in Education that will fund new teaching programs.

Not to be left out, Inge Gedo, president of the Class of 1985, whose diplomas were not yet a week old, reported a class gift of \$3,826. Supplemented by more than \$5,500 as a "matching" gift from the Class of 1935, the fund will be used to landscape an "oasis" near the West Campus houses. Furthermore, she said, her classmates had pledged to give

a total of \$19,200, mostly for scholarships, before 1989.

Mary Frances Wagley, '47, presiding at the luncheon as one of the last official acts of her Alumni Association presidency, announced three additional gifts:

- \$1,910,000 from the 60th-anniversary Class of 1925.
- Nearly \$40,000 from the Class of 1975 to celebrate its 10th reunion. Of that, according to reunion gift chairman Peter J. Mancuso, \$31,000 is designated for the Class of 1975 Student Aid Fund.
- \$25,000 from the Class of 1980 as endowment for a student aid fund.

Responding to this abundance for alma mater, President Paul E. Gray, '54, characterized it as "enormously important . . . tangible evidence of caring and support."

But pressures on the M.I.T. budget outstrip these efforts, warned Gray, and he previewed plans for a major program to fund core needs—education, student aid, and unrestricted endowment. Preparations will be completed by 1987, said Gray, for a new effort in which all alumni will be asked to help present the case for M.I.T. as a national resource as well as provide direct support.

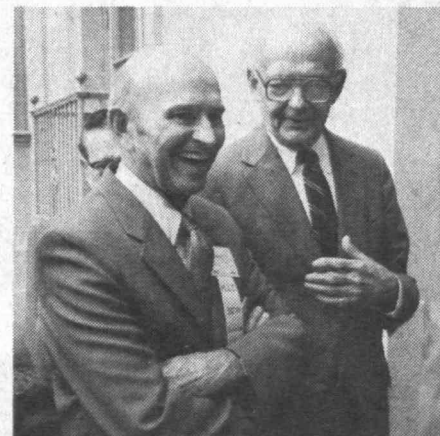
Mary Frances Wagley concluded on an optimistic note. In her year as Alumni Association president, she said, she spoke to 15 M.I.T. clubs and nine other M.I.T.-related groups—her farthest trip was to Taipei. Invariably, she said, she was "impressed everywhere by the continuing involvement of alumni in M.I.T." Her thanks went to all alumni, she said, for a year of experiences that she will never forget. *John Mattill* □

*M.I.T. Reunions took full advantage of Boston, a city wrapped around an historic harbor. Above: dinner and dancing was set up for the Class of '75 on the Boston Tea Party Ship, appropriately named the "Beaver". Right: the *Bostonia II* berths at Long Wharf to take on members of the Class of '65 and their families for a cruise to Thompson's Island.*





Right: The dance band for the Class of '60's dinner at the Hyatt Regency Hotel drew Tim Hart and Linda Sprague onto the floor. Far right: Marty Plys (hat) and Frank Wojtowicz were among the members of the Class of '80 who finished off Reunion with a leisurely brunch.



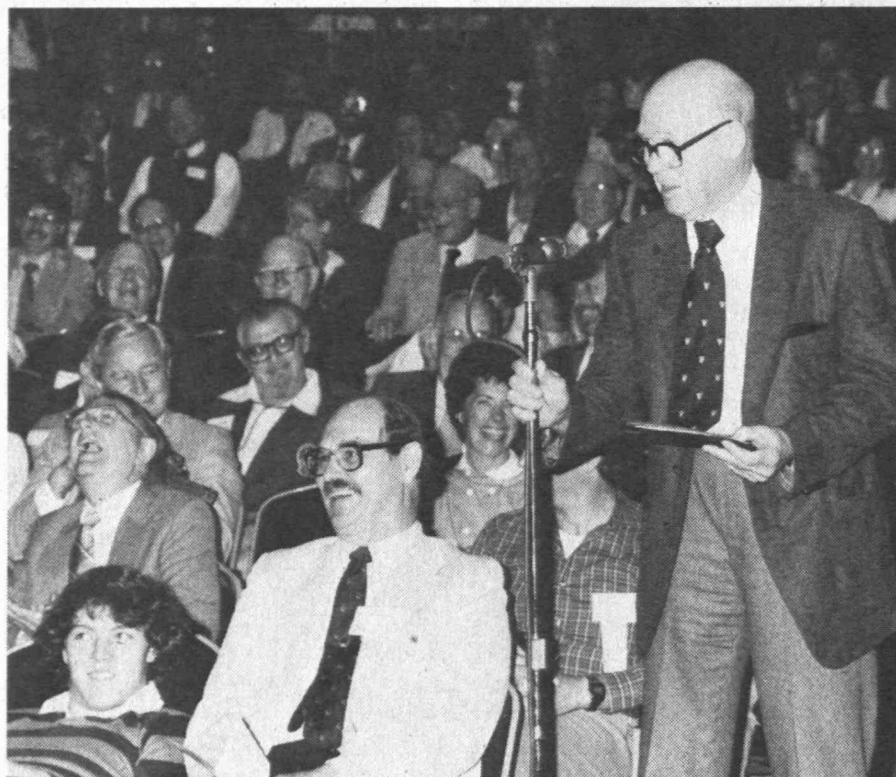
Fund raisers extraordinaire! Top of page: Reunion gift chairman John Taplin, '35, with his wife Virginia, is proud of his class' 96 percent participation rate and \$3.74 million gift. First row of photos, left to right: Barry Bronfin, the Class of '60's gift chairman, announced an all-time record for a 25th reunion class — \$1.96 million from 67 percent of the grads; Inge Gedo, president of the Class of '85, reported a class gift of \$3,826 and a further pledge of almost \$20,000 by 1989; and Chris Boland, '45, with his wife Jean, had more good news—67 percent of his classmates averaged over \$5,000 each for a 40th reunion gift of \$1.25 million.



Bottom row of photos, left to right: David Saxon, '41, chairman of the Corporation, raises a glass with Bernie Nelson, president of the Class of '35; even the early summer charms of a reception in the president's garden didn't distract Thomas Farquhar '60 (facing camera) from discussions on his class' spectacular 25th reunion gift; and Richard Bailey and Arthur King, both '35, enjoyed President Gray's reception. Left: "As the first man to succeed the first woman (president of the Alumni Association), I have my work cut out for me," quipped E. Milton Bevington, '49, as he accepted the "gavel of power" from Mary Frances Wagley, '47.



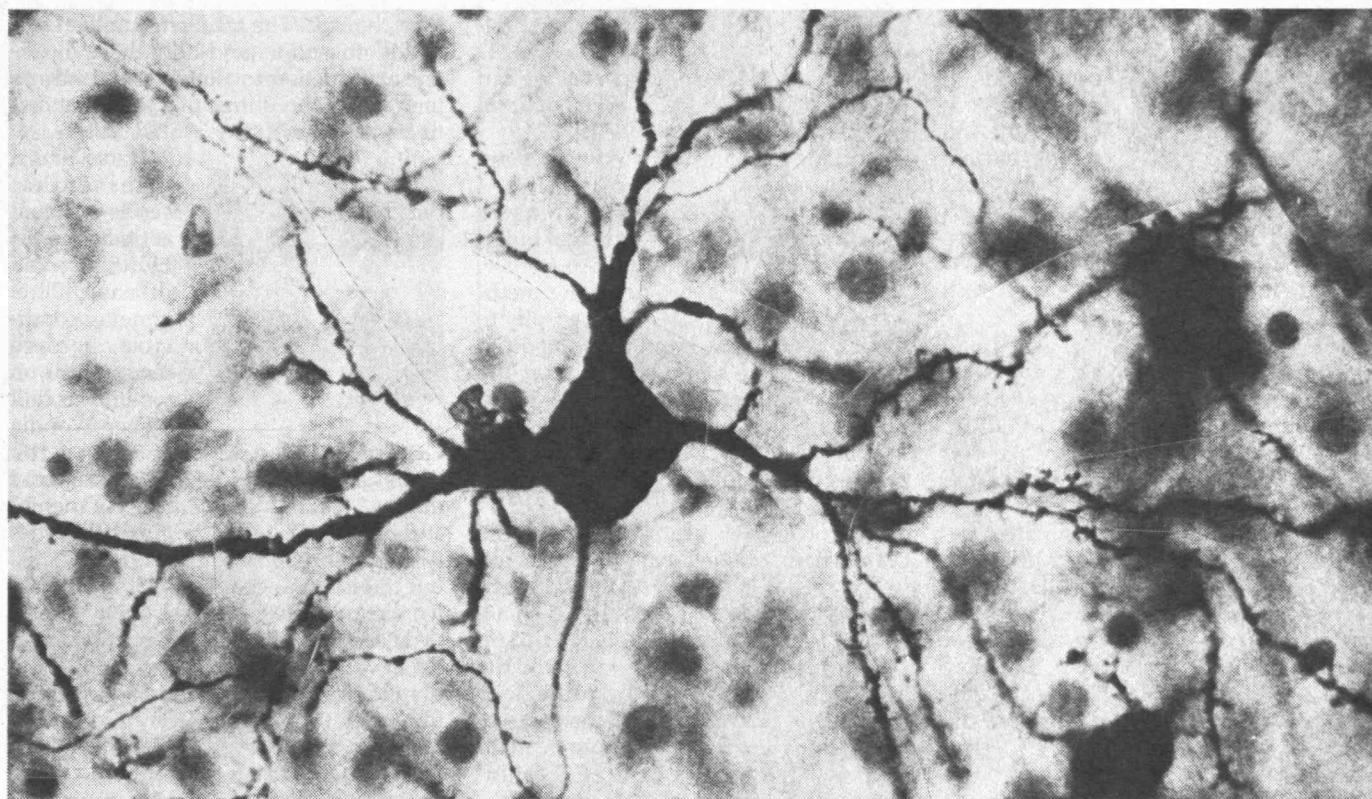
Above: When the River City All Stars barbershop quartet regaled the Class of '25 at their reunion dinner, the audience could not resist joining in. Far left: the harbor cruise gave the Class of '65 good appetite for their Thompson's Island picnic, complete with a DJ and dancing. M.I.T. reunions, which may include as many as 15 separate programs plus Technology Day, are among the accomplishments that won the 1985 Planner of the Year Award from the New England Chapter of Meeting Planners International for Joseph J. Martori (left), associate secretary of the Alumni Association.



Clockwise from top: The popular Class of '65 dinner dance was held at the new Boston Computer Museum, where grad Bruce Sunstein and guest Rachel Goodwin enjoyed crowd-free exhibits. Karen Mathiasen, '71, as the chairperson for Technology Day, proposed herself as "something everyone is waiting for—the last speaker." After the luncheon, Larry Stone, '35, and Cele Taubman held a post-mortem in the sun. Maria and Elizabeth Simon, granddaughters of Al Bowen, '45, are offered pre-Pops nibbles by their father, Fred Simon. Ed and Goldie Ann Friedman arrived early to register for Class of '35 activities. Ted Rimbach, '34, had graduates in gales of laughter at an otherwise somewhat serious Technology Day.



Dispatch from the Cutting Edge of the Life Sciences



It may come as a surprise that life science has become so pervasive at M.I.T.," declared the new Dean of Science Gene M. Brown, in one of his last tasks as head of the Biology Department. In fact, biology has spread its seeds widely throughout the Institute, to emerge full-flowered as a subject of study in the Departments of Civil, Mechanical, Electrical, and Chemical Engineering, and Aeronautics and Astronautics.

What is no surprise is the fact that, as Brown put it, life science researchers at M.I.T. have made several of the "terribly exciting breakthroughs" in understanding what makes us all tick. What more natural, then, than to impart some of the essence of the new biology to graduates returning for Technology Day June 7?

Of course, the major barriers between the physical and life sciences have long been breached. Researchers in many of

*Tools of
physical science
are providing insights
into what makes
us tick.*

the sub-fields of modern biology routinely measure voltages, monitor complex chemical reactions, and use radioactive tracers. So even the physical scientists and engineers in the audience had some familiar points of reference as they listened to four M.I.T. faculty members summarize work on the cutting edges of immunology, neurosci-

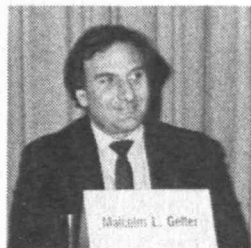
ence, human genetics, and cancer biology. Unfazed by the occasional unreadable slide, the alumni eagerly followed the morning's mini-tutorials and lined up later to question the speakers.

What is fascinating about immunology, said biology professor Malcolm L. Gelfand, is understanding the mechanism by which the immune system works and determining how pathogens learn to avoid the ravages of the system. The task of the immune system, explained Gelfand, is to discriminate between "self" and "non-self"—between the components of the body to which the system belongs and every other living thing.

The mechanisms underlying the functioning of a brain cell like that pictured above are essentially the same as those in other cells of our bodies.



The new dean of science, Gene Brown, moderated the Technology Day panel on the life sciences.



The specificity of "self" compounds is exquisite. As a result, the immune system must be artificially suppressed to allow sur-

geons to transplant kidneys, hearts, and other organs from one individual to another. Ideally, said Gefter, immunologists would like to decode the system in such a way that they can prevent the recognition of non-self compounds in such circumstances.

That type of understanding should also help researchers to puzzle out why the immune system's discrimination between self and non-self occasionally breaks down. Allergies, in which the immune system overreacts and works at too strong a level, provide simple examples of such a breakdown. But they are simple only in their familiarity. The basis of discrimination is "one of the great mysteries of immunology," conceded Gefter.

Less of a mystery is what happens once the immune system recognizes an invader. Work at M.I.T. and other institutions has revealed that cells carrying the antibodies that attach themselves to alien objects and take them out of circulation grow and divide once the invasion is recognized. The antibodies assume shapes that are exactly complementary to those of the foreign objects, enabling the antibodies to bind them tightly. Researchers hope eventually to mimic nature. "Once we know how antibodies are constructed in detail," said Gefter, "we can make them in the test-tube and use biology to back up the body's immune system."

An Attack at the Cellular Level

If immunology is maturing, neurobiology is a discipline that's just reached adolescence. "There's a real excitement at M.I.T. and other centers of research on the cell and molecular biology of the

brain," enthused professor of psychology Ann M. Graybiel, Ph.D. '71. "There's a feeling in the air that we can tackle the fundamental problem of brain and behavior at the cellular level."

Attacking the problem involves research at several levels of complexity. At one end, neurobiologists intensely study neurons—the fundamental building blocks of the brain. At the other, researchers use such monitoring methods as positron emission tomography to detect increases in the flow of blood to the brain—and hence focus in on the areas that are most active at any given time. Those studies, said Graybiel, have shown "that the sheer geometry of the brain is important to its function—a fact never suspected before."

Neurobiologists are zeroing in on the brain's first volition area. That's a region in the frontal lobe that is active whenever the brain's owner is doing something or thinking about doing something. Surprisingly, much of the input to this area comes from the deep core of the brain. "In fact, the roots of many diseases that affect human mentation—Alzheimer's disease, Parkinson's disease, and mental illnesses—come from deep in the core of the brain," said Graybiel. "The conviction



has emerged that, in some way, the deep core of the brain containing the chemical dopamine collaborates with the cortex (the outer layer) to produce movements and the normal flow of thought. In some way these two movements—mental and physical—are connected."

Neuroscience is scarcely an end in itself. "The mechanisms that underlie even the highest functions of the brain," explained Graybiel, are fundamentally the same as those used by other cells, whether they are blood cells, cells involved in digestion, or cells of seemingly

inert bone." The challenge, she said, will be to understand how these mechanisms function to allow us to think, to feel—to do the things that are most distinctly human.



One brain disease that sends normal activity awry is Huntington's disease. This genetic condition, whose most famous victim was folk singer Woodie

Guthrie, causes degeneration of the brain's basal ganglia—the central gray matter—leading to severe loss of mental and muscular function. It strikes between 5 and 10 Americans per 100,000 but tragically does not reveal itself until its victims have reached their 30s or early 40s—and have thus produced children who may themselves carry the dominant gene and be doomed to repeat the tragic cycle. However, work outlined by associate professor of biology David E. Housman may provide some hope of understanding the causes of Huntington's and other disabling genetic conditions.

Housman reported success of a five-year search by scientists at M.I.T. and the Massachusetts General Hospital to discover a molecular marker for the gene that causes Huntington's disease. The marker is a single piece of DNA, the thread of life, that medical researchers can use to track the specific chromosome that carries the Huntington's gene through a whole population.

The group studied a population on the shore of Venezuela's Lake Maracaibo, where the incidence of Huntington's is an appalling one in ten. To identify the location of the bad gene successfully, the group applied the techniques of recombinant DNA technology, among them the use of "restriction endonuclease enzymes" that cut chains of DNA only at specific points.

The significance of the work for Huntington's victims is threefold, according

Conchita Adopted M.I.T. for Life

to Housman. A diagnostic test will shortly be available to tell patients at risk whether or not they will have the disease, with 95 percent certainty. A fetal test should follow soon that will identify future victims of the disease while they are still in the womb. And with a great deal of work, researchers hope to locate the actual defect responsible for the condition, and possibly find a therapy for helping victims. In future, said Housman, such research might be applied to other genetic ailments, among them cystic fibrosis, muscular dystrophy, and sickle cell anemia.

Cancer: Many Diseases or One Molecular Change?



Recombinant DNA technology is also producing strides in understanding the bases of cancer, according to Robert A. Weinberg, '64,

professor of biology and a member of the Whitehead Institute. In particular, it enables cancer researchers to identify and clone oncogenes—the genes in cancer cells believed responsible for altering cellular behavior in malignant ways.

The work shows that many oncogenes differ remarkably little from normal genes. Three years ago, for example, an M.I.T. group identified a difference between an oncogene and a normal gene of one single chemical group. The major question, said Weinberg, is how such similar entities can have such profound differences on cells.

The concentration on oncogenes has led to a fundamental change of attitude toward cancers, declared Weinberg. Whereas a few years ago researchers regarded cancer as a wide spectrum of different diseases, it now appears that the multitude of cancers may stem from just a few basic molecular causes.—*Peter Gwynne* □



This year the photographer captured Conchita Lobbell Pearson, Hon '17, greeting an old friend at Pops Night. But on countless occasions in the last 30 years, other Reunion-goers have enjoyed the clasp of those small, soft hands and the look of total attention in the Latin eyes.

Harold E. (Lobby) Lobbell, '17, was the first executive vice-president of the Alumni Association when he met Conchita on a 1949 visit to the M.I.T. Club of Mexico City. They were married in 1954.

Having never seen Boston, she accepted the climate, the culture, the Institute's style and traditions, "just happy to meet all these interesting people."

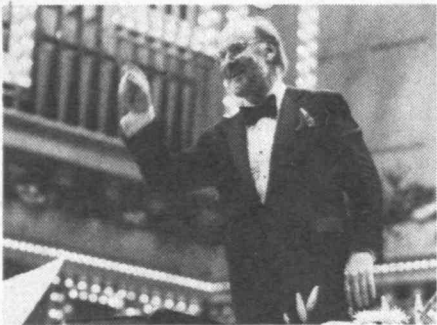
Sorrow struck twice. Lobby, and Con-

chita's second husband, Harry Pearson, '23, each died before he could enjoy retirement in Mexico. Conchita resettled in her homeland, but she has been a regular at Mexican Fiesta and Reunion ever since.

What impresses her most about M.I.T. is the fact that "the ones who really do things are so modest, so close to the ground . . . so easy to talk to, so human."

Her memories are rich—including a private tour of Versailles with Wells Bosworth, '89, designer of the main M.I.T. buildings, who was then in charge of maintenance for the French palace. But her focus is on the present, on the person before her, whose hands she holds closely in hers.—*Susan Lewis* □

POPS



John Williams (left) took to the familiar podium at Symphony Hall in this, the Pops' 100th season, to offer alumni the usual charms of good company and good music.



Gene Brown Is Dean of Science

The School of Science has a new dean—Professor Gene M. Brown, a noted enzymologist who formerly headed the Department of Biology. As dean, Brown succeeds Professor John M. Deutch, '61, now provost.

Brown joined the M.I.T. faculty in 1954, a year after he received his Ph.D. in biochemistry from the University of Wisconsin. He has focused his research on the methylation of nucleic acids and the isolation, biosynthesis and function of vitamins, coenzymes and related substances. He became head of the Department of Biology in 1977, following five years as executive officer and five as associate head. Under Brown's leadership, the faculty and doctoral programs in three disciplines in the Department of Biology—biochemistry, microbiology, and cellular and molecular biology—were rated first or tied for first nationally in a National Research Council report assessing U.S. research-doctorate programs. □

Fulmer Retires

Vincent A. Fulmer, S.M. '53, secretary of the Institute since 1963 and secretary of the Corporation since 1979, has taken early retirement effective last June 30 after 34 years of service to M.I.T.

Both Corporation Chairman David S. Saxon, '41, and President Paul E. Gray, '54, in letters to the Corporation and Faculty Council, said "It has been 34 years of weekdays, weeknights, and weekends at the Institute, years of foregone vacations and holidays as well."

Fulmer came to M.I.T. in 1951 as a teaching assistant in the Department of Economics, where he took his master's degree two years later. Then began his responsibilities in the M.I.T. administration—first as an industrial liaison officer, then as acting director of the Industrial Liaison Program, executive

assistant to the chairman of the Corporation, and vice-president and secretary.

Fulmer's 25-year association with the Institute's governing body has involved 100 Corporation meetings, more than 400 Visiting Committee meetings, and more than 100 building dedications, presidential inaugurations and Institute convocations. □

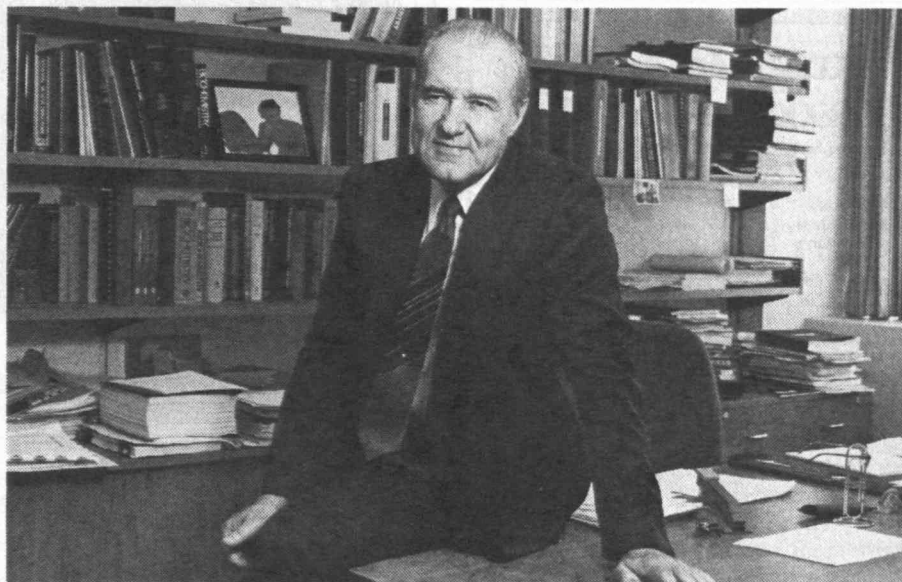


Biotechnology Draws Major NSF Funding

As one of six institutions to operate new NSF "engineering research centers," M.I.T. will receive up to \$20 million from the National Science Foundation between now and 1990.

The first grant under the program, approximately \$2.2 million, will establish a Center for Biotechnology Process Engineering under the direction of Professor Daniel I. C. Wang, '59. The center will focus on four areas of research: genetics and molecular biology, bioreactor design and operations, product isolation and purification, and biochemical process systems engineering, and is expected to enhance U.S. competitiveness in biotechnology.

Other NSF grantees under the program are the University of California at Santa Barbara, Columbia, the University of Delaware (in collaboration with Rutgers), the University of Maryland (in collaboration with Harvard), and Purdue. Some 106 institutions submitted proposals for a share of the \$95 million. □



(Top) Vincent Fulmer, S.M. '53; (immediately above) Gene Brown

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UNDER THE DOMES

CONTINUED

Broadened Focus on Policy Issues

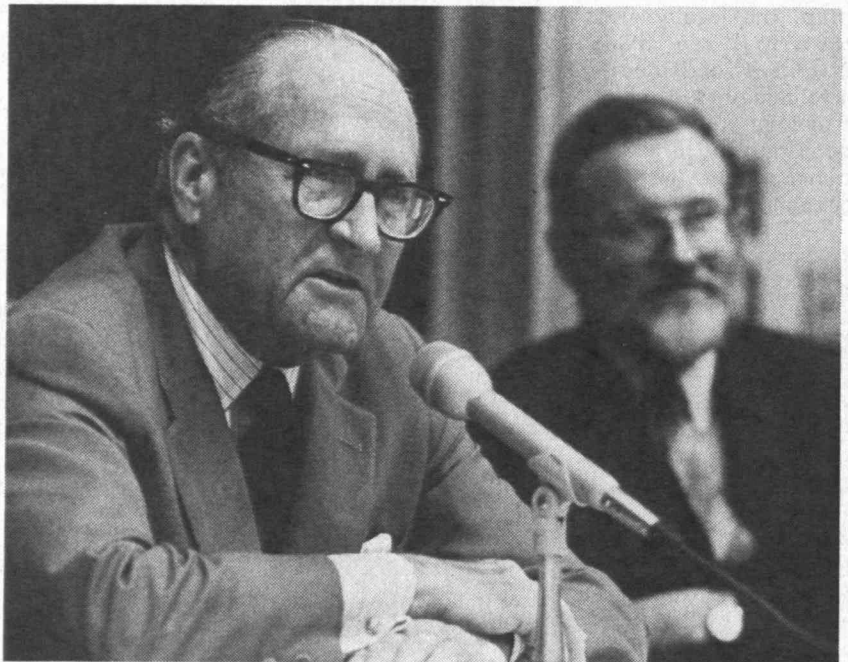
Teaching and research in technology and policy in the School of Engineering, long decentralized in several autonomous centers and programs, has now been brought together into a new Center for Technology, Policy and Industrial Development under the direction of Professor Daniel Roos, '61, of the Department of Civil Engineering.

The CTPID's teaching program will be an enhanced version of the existing interdisciplinary Technology and Policy Program, with Professor Richard L. de Neufville, '60, continuing as its director. CTPID will absorb the Center for Policy

Alternatives, whose director since 1983, Professor Nicholas A. Ashford, will have a major role in the new programs.

Roos was appointed Japan Steel Industry Professor, a chair endowed in 1975 by a \$1 million gift from the Japan Iron and Steel Federation. He says CTPID "will be deeply involved in studying how technology and industrial development can be advanced in socially responsible ways."

Roos has been director of the Center for Transportation Studies since 1978, and he has just finished codirecting its most ambitious project—a long-term study of the future of the automobile. He characterized this program as an example of effectively addressing technology and policy questions with broad international social aspects. □



Ambassador Gerard Smith (left) and M.I.T. political science professor George Rathjens were among the leaders of the joint Harvard-M.I.T.

Summer Program on Nuclear Weapons and Arms Control, which enrolled more than 50 college faculty members from seven countries.

Their investment in tennis brought big returns for Lisa Shields, '85 (right) and her coach, Candy Royer (inset). Shields is one of four M.I.T. athletes named to the 1985 College Sports Academic All-America team, and Royer was named Division III Coach of the Year.

Conquering "Big" Research

The U.S. is leading a movement toward "new strategies for technological innovation," says Edward E. David, Jr., Sc.D.'50, president of Exxon Research and Engineering Co. The goal is to retain the advantages of small-scale research and development—informal and frequent communications among researchers and simple funding plans—in an era of "big science" when large-scale research is vital.

Required are leaders who can make judgements about which technologies are at their limit of efficiency, and which can make great gains through industrially-driven R&D.

Under prevailing conditions, said David, those who excel in innovation will have "a genius for integrating parts, for overcoming the institutional and cultural barriers that spring up wherever people coalesce in divisions and departments."

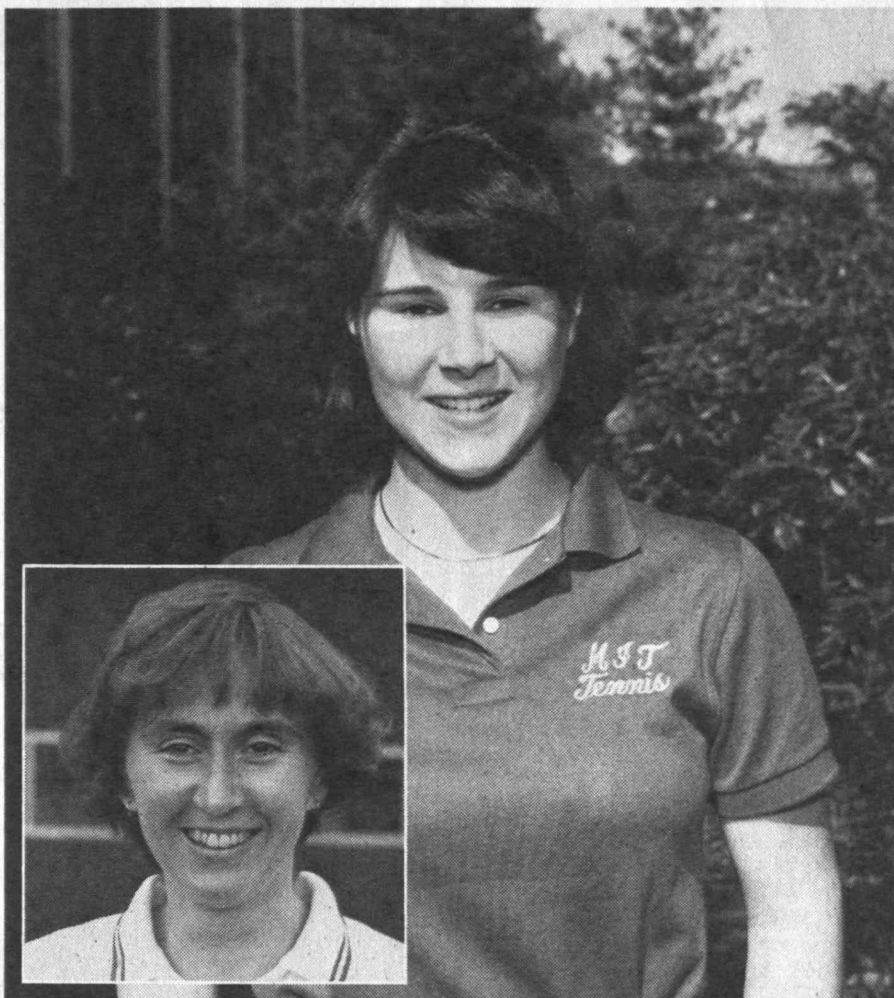
David elected to speak at M.I.T. last spring when offered the 1985 Arthur M. Bueche Medal and lectureship by the National Academy of Engineering. □

Candy Royer Coach of the Year

Women's tennis coach Candy Royer has been named as the national Division III coach-of-the-year by the Intercollegiate Tennis Coaches Association.

Royer led MIT to a 14-2 record this past season, the team's best mark in 11 years of varsity competition. She has served as women's tennis coach and assistant professor of physical education at MIT for the past four years.

A native of Sunbury, Pa., Royer is a 1971 graduate of Penn State University where she coached the women's tennis squad for four years before joining the MIT staff in 1981. □



Scholar-Athletes Honored

Four M.I.T. athletes have been named to the 1985 Academic All-America team, sponsored by the College Sports Information Directors of American (CoSIDA). Named to the College Division At-Large first team were Clifford J. Eskey '85 (riflery); Patrice M. Parris '85 (track & field), Andrew A. Renshaw '85 (swimming), and Lisa A. Shields '85 (tennis).

Eskey, a native of Bethesda, Md., finished third in the smallbore competition at the 1985 NCAA Championships, first among 49 shooters at the 1985 Mid-Atlantic and Metropolitan Intercollegiate Championships, and was four-time team MVP. Eskey had a cumulative grade-point-average (GPA) of 5.0 (on a 5.0 scale) in chemical engineering.

In 1985 NCAA Division III competition, Parris was the indoor champion in the 35-lb. weight throw and the outdoor national runner-up in the hammer throw. A native of Georgetown, Guyana, he received M.I.T.'s "Class of 1948

Award" as the top male senior athlete-of-the-year and the "Malcolm G. Kispert Award" as the top male senior scholar-athlete. Parris posted a GPA of 4.7 in electrical engineering and physics.

Renshaw was named first-team Academic All-America for the second straight year. The McKownville, N.Y. native finished first in the 100-yard butterfly at the New England Championships and was second in the 100 butterfly at the 1985 NCAA Division III Championships. He also was the team's MVP four straight years. In the classroom, Renshaw had a GPA of 4.8 in biology/nutrition.

Shields, from Toronto, Ontario, was the only New England athlete on the 10-player women's honor team. She posted an 11-4 record in singles competition in leading the Engineers to a 14-2 mark for their best record ever. Shields also received M.I.T.'s "Malcolm G. Kispert Award" as the top woman senior scholar-athlete and the "Pewter Bowl Award" for leadership and inspiration to teammates in intercollegiate competition. She had a GPA of 4.5 in aeronautics and astronautics. □

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CLASSES

NEWS FROM YOUR CLASSMATES

07

John C. Bradley, 469 Farmington Ave., Waterbury, CT 06710, celebrated his 100th birthday last February 16. "Nothing I've seen in my life has surprised me," he says, "and it wouldn't have made any difference if it had, because things would have changed anyway."

Mr. Bradley has spent most of his life in Waterbury, working for American Brass Co. as a metallurgist, a job he began in 1907. "I worked for them until 1956, making the best brass in the world," he says. Hobbies over the years included gardening, birdwatching, working with the Boy Scouts, hiking, shell collecting, and bee keeping. He still does a little gardening. Much of his time now is spent sitting by the fireplace, reading, talking, thinking about his life.

He would like to hear from '07 classmates.—ed.

08

Mrs. Osborne and I went to the Technology Day luncheon this year. I was the only member of the class of 1908 and was welcomed royally. I had written **Franklin Towle**, who represented the class last year, but he replied that he now needs a wheelchair to go anywhere. Consequently, he couldn't make it to the luncheon in Cambridge.

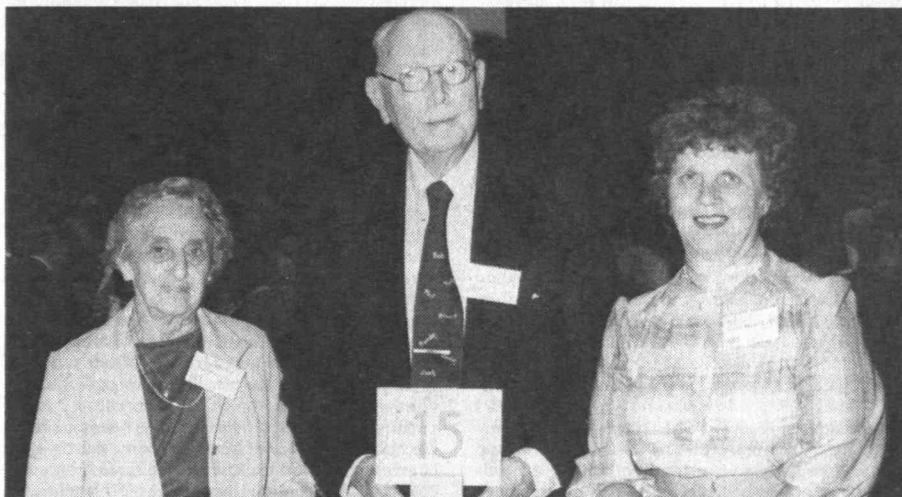
We have word that **Leo Loeb** died about a year ago. . . . Dorothy and I plan to go to the luncheon next year if we can, but I shall be 98 (nearly 99) years of age then, so we are uncertain whether I will still be well and mobile. Best wishes.—**Harold S. Osborne**, Secretary, Rt. 1, Box 23, Penacook Rd., Contoocook, NH 03229

15

My first opportunity to put news in about Technology Day! By the time you read this each '15er will have received a special 1915 newsletter, which was **Bob Warren's** idea, consisting of tidings and news from each classmate obtained through personal telephone calls. How much fun **Bob Warren**, Amy Ford Stearns, widow of **Edward Stearns**, and I (along with Mary Kyger, Joe Rechio, and Gloria Westover from the Alumni Office) had making these calls!

I was shocked and surprised to be made an honorary member of the Alumni Association. I received a certificate and beaver stick pin, and felt so privileged when I went to the platform to receive them. It was made possible by you '15ers! . . . Amy and I stayed at **Bob Warren's** summer home at Buzzards Bay for the weekend, and it was delightful!

Now for my old faithful, **Loring Hall**. He has included some social activities in his upcoming diary notes. In his first 19 years, Loring didn't have time to pay much attention to girls but then discovered some of them could be "charming companions or challenging puzzles." The fly leaf of his 1914 diary carries this quotation from Dis-



Representing Class of 1915 at Technology Day 1985 are Amy (Mrs. Edward) Stearns (left), Robert Warren, and Joyce Brado, acting secretary and class

agent. Brado was awarded by honorary membership in the Alumni Association for her outstanding service to alumni (Photo: Frank Revi, '86)

raeli: "The secret of success in life is for a man to be ready for the opportunity when it comes."

January 1, 1914: (Notice that New Years' Day was not a holiday at M.I.T. then.) Went to the 10 a.m. lecture on lithology, then studied Spanish. Decided to drop the latter for the rest of the term, as it takes too much of my time. **Gallager** and I finished the experiment on Wheatstone's Bridge. Worked on applied mechanics all evening.

January 2, 1914: After the EEE lecture, went to Ridgehaven Inn, where I completed the installation of their gas-lighter system. Got paid at last (\$9.40) and felt like a millionaire. Played chess with **Tom Jewett** and beat him.

January 7, 1914: Worked on my profile drawing all morning, then on the plane-table map of Jacksonville. Put in part of the river-water-lining and found it to be a tedious job. In the evening worked out five EEE problems due Saturday.

January 8, 1914: In political economy, Professor Dewey explained to us the new currency act, which had been difficult for most of us to understand. In the afternoon **John Gallagher** and I worked like beavers for three and a half hours on the experiment called "D.C. Generator Characteristics, Shunt and Compound." We took 60 readings. Came home with **Billy Brigham**.

January 10, 1914: Went skating at Franklin Field. The ice was good, and we skated about four hours. The M.I.T. wrestling team defeated Brown tonight.

January 11, 1914: It was announced that the corporations of M.I.T. and Harvard have voted to combine their civil, mechanical, mining and sani-

tary engineering departments after Tech moves across the river into Cambridge.

January 14, 1914: For the third day, it was below zero. In fact today's 10° was the lowest in Boston's history. All transit tied up, and both railroad stations filled with stranded passengers. Big Roxbury fire added to the misery.

January 19, 1914: Went to Geology lecture with **Charlie Morse** and **Harold Pickering**. Came home on the train with **Carl Dunn**.

January 20, 1914: Had our final geology exam. Had lunch with **Paul Connor** and **Marshall Dalton**.

January 23, 1914: Went over to Franklin Park with **Edgar Bascom** and **Alfred Clarke** to get some rock specimens from the "Bottomless Pit" there.

January 24, 1914: Took the "pol econ" exam and stayed around for the usual post-mortem talk afterward. Walked over to town with **Art Bond** and got a haircut - 25¢. Took Katherine to the afternoon show at Keith's. Had a date with Marguerite in the evening.

January 26, 1914: The physics "heat" exam was tough, but I managed to get through. Received a check for \$54.15 from the TACU Co., representing my commission on the sales by Gurney, Bassett, and Lowe last summer. Hope to sign up ten salesmen this year.

January 27, 1914: Today it was the applied mechanics exam, another toughie. Licked **Eddie Upham** at a game of chess before coming home.

January 30, 1914: Took a geology trip to Blue Hill with **Daniels**, **Hayward**, and **King**. Observed

an immense batholith of fine-grained granite, which had been glaciated. Also visited Houghton's Pound, which was formed in the glacier.

February 9, 1914: Got my marks for the first term—9 C's and 4 P's, far better than I had expected. My cup is full.

And so, Fifteeners, we will continue in the next issue starting with the 2nd semester of 1914!

Robert Welles (electrical engineering) passed away May 4, 1985. He was a very active supporter of M.I.T. Bob served as president of the M.I.T. Club of Southern California in 1958 and participated in the M.I.T. second century fund activity, 1961-1963, and the regional gift program, 1976-1978. He was chairman of the Educational Council for southern California 1962-1973. In 1964 he was awarded the Bronze Beaver for service to the Institute, the highest honor the Alumni Association could bestow. Bob was appointed a life governor of the M.I.T. Club in 1964 and, since that time, served as chairman of the Pasadena Unit of the club.

He built the Educational Council in southern California into one of the most active councils, and he had an informal supper at his home every summer for students home on vacation. There they met with incoming freshmen to help acquaint them with life at M.I.T. That program is now a tradition and is observed annually. I personally received many letters from Bob, just full of bubbling over enthusiasm and news, and we will all miss him! . . . Please keep in touch with me '15ers—you know, you are a wonderful gang!—**Joyce E. Brado**, Acting Secretary, 491 Davison Rd., Apt. 9, Lockport, NY 14094

16

Allan Pettee made us very happy with this note: "Outside of common complaints such as arthritis, dimmed vision, and hearing, I'm holding up well. Retired to Tyron, N.C., keeping up with current events, 12 grandchildren (from three children) and soon to be seven great-grandchildren. I'll be 96 on Labor Day, and am looking forward to my second viewing of Halley's Comet (which I recall as disappointing the last time around)."

How about this note of encouragement from **Dan Comiskey**: "Mrs. Stanley Warshaw, daughter-in-law of **Nat Warshaw**, tells me that Nat is well and has just moved again. They expected to see him shortly. Grace continues well, can't walk alone, but goes out for rides and visits friends. Please remember us to Sibyl, who I hope is well. Yes, most of us are now 90-plus. A doctor here tells the Retired Men's Club (350 members) that 100 is now possible for most of us with proper food and exercise." . . . **Will Wylde** continues that positive note in his letter. "I am very hopeful of coming, with my wife of course, to next year's reunion. I have not attended one since our 50th. We do go up to western Massachusetts every year to attend a yearly reunion of my family which was started by my parents way back in the 1920s. It is always held in late August which made it impossible to attend any reunions in June or July. Now the date of my family reunion has been set permanently for the fourth Saturday in August. If it is possible for the 1916 Class Reunion to be held on a week or so from that weekend, we would surely be able to attend. I believe that you did have it last August and I hope you will find it possible to do it again then but please not that weekend. This year Dannie and I are leaving here in about two weeks for an extended auto tour to the Canadian Rockies. We will be back in North Adams, Mass., for a week or so before the 4th Saturday in August so it will be very doubtful whether we could attend any class reunion this year."

Thanks for you letters. Keep them coming. We are interested and concerned for each other. We continue to enjoy and our bond is strengthened by the happy memories of the good times that we shared together.—**Bob O'Brien**, Acting Secretary, H.E. Fletcher Co., Groton Rd., W. Chelmsford,

MA 01863, (617) 251-4031 or 935-3750, ext. 204

17

Colonel **Jesse Rogers** has deserted Needham, Mass. for retirement at Rogerson House, 434 Jamaica Way, Boston, MA 02130. . . . **Henry "Tubby" Strout** has moved to Kansas, where his daughter lives. He can be written to in care of J.A. Stokes, 2465 Arkansas St., Lawrence, KS 66044. . . . Colonel **Lawrence L. Clayton**, who lived in Wesley Manor, Jacksonville, Fla. is reported to have died sometime in 1984. . . . **Albert W. Chase**, died on April 12, 1985. His home was in Foxboro, Mass. He is survived by his widow, **Adelia**, to whom we send our sympathy.—**Walter J. Beadle**, Secretary, Kendal at Longwood, Box 217, Kennett Square, PA 19348

18

At this time of the year there is a dearth of news of activities from you. We are happy to report that on May 30th there was a 90th birthday celebration at Boca Raton, Fla., for **Charlie Taverner**. An urgent telephone call from him asked us to come down for this occasion—but regrettably we were unable to make this trip. We do know, however, that the party (and three others) was overwhelming with over 230 people including the mayor, the city council, the Exchange Club, the English Speaking Union, Music Guild of Boca Raton, Boca Raton Redevelopment Agency, and many other organizations in which Charlie is a fi-rebrand. At 90 Charlie is Mr. Boca Raton and gives of himself to the utmost. More power to you.

Your secretary and Selma will be moving before the end of July to a retirement colony called North Hill, 865 Central Ave., Needham, MA 02192—a new community of about 350 families. We will tell you more about this new adventure for us in the next issue.

It is with sorrow that I record the death of **Jorge Perra Polo** in Cali, Columbia, on February 16, 1985. Many of you will recall the pleasure we had being with him and his good wife at our 50th reunion. He divided his time between his home in Columbia and New York. His classmates of M.I.T. in Columbia note that he was undoubtedly one of the outstanding engineers of his country, and an easy going and enthusiastic friend. . . . A note from Peter Craighead advises us of the passing of his father, **Philip Craighead**, on March 25, 1985 at the age of 90. . . . From the Alumni Office news that **Samuel Harrison Chamberlain, Jr.** of 57 Warren Avenue, Plymouth, Mass., died on July 7, 1984—no further details.—**Max Seltzer**, Secretary, 1443 Beacon St., Brookline, MA 02146; **Leonard I. Levine**, Assistant Secretary, 599 Washington St., Brookline, MA 02146

19

We would like to tell you about your 1919 class activities but at this time we are without any news items. Reading the class notes of other early classes we find they get more letters than we do. A recent issue of the *Review* had one such letter from a member that attended an early aviation meet. The meet was held in Squantum, Mass., in 1909. Your Secretary was there also and saw **Graham White** fly a monoplane with a Bleriot engine, in which the cylinders rotate with the propeller, to Boston Light and back to win a prize of \$10,000. Also **Madam Quimby** flew a lighter than air airship to Boston; she was scheduled to light at the State House but mistook the dome of the Christian Science church and landed in a nearby dump. Of course the Wright brothers were there flying their biplane.

With regret we report the death of **Russell H. Savage** on April 5, 1985; his home was in Riviera Beach, Fla. Also the death in 1985 of **Ervin M.**

Kenison. If more information comes to hand it will be reported in a later column. We recall with pleasure these two men while at the Institute.

We would welcome a letter from any classmate to keep our 1919 column alive.—**W.A. Langille**, Secretary, Box 144, Gladstone, N.J. 07934

20

I am happy to report that the 1920 reunion was a success. In attendance were **Al Burke**, **Perk Bugbee**, **Pat and Buzz Burroughs**, **Ann and Bink Carleton**, **Emily and Al Fraser**, **Mary and Henry Hills**, **Ross Nebolsine**, **Phil Wait**, **Elbridge Watson** and his daughter. At the class banquet, held in a special meeting room at the dormitory, letters were read from several prominent classmates expressing good wishes to those present. A letter from **Lee Thomas** mentioned **K.B. White** whom he used to see in Paris and visited at his castle. **Irv Wilson** requested remembrance and talked of his record number of 13 grandchildren and 15 great grandchildren. **Jack Nolen** also sent greetings to the class and regrets at inability to be present. **Count Dumas**, recently moved to 350 Chemin Ste. Foy, Quebec from his beautiful home on Brown Avenue. A faithful attendant in years past, he asked to be remembered to all those present. **George Wilson** had expected to be with us but a conflicting date as guest of honor at a Quincy High School reunion prevented. I am happy to report that George is in good health and still bowls regularly. I neglected to mention that **Hannah (Mrs. Harry) Kahn** was present at the alumni luncheon. **Vera Howes**, widow of Homer, honored the 65th by sending a very generous check to the Alumni Fund in honor of one of the class' most distinguished classmates.

Now, for some less happy news. **Myron Clark** died on June 22. He had long lived in Farmington, Conn. He served as lieutenant in the Army Air Force during World War I, came to Hartford in 1929 and became manager of the Hartford office of Estabrook and Co. Later he was associated with Tucker Anthony and R.L. Day. He served on the boards of the American School for the Deaf, Farmington Red Cross, Hillstead Museum, Bond Club of Hartford, Farmington Country Club and was finance chairman of the Missionary Society of Connecticut. He leaves his wife, Mary, a son and a daughter, ten grandchildren and a great grandchild. For this information I am indebted to Tom Green, '26, who said "Myron was greatly liked and respected around the Hartford area. He was generally regarded as one of the soundest and most astute of financial advisors in the Hartford community." A first class citizen in every respect, he will be missed by many of his classmates.

Jim Scott of Richmond, Va., died on March 21. Always an active and interested member of the class he was a prominent sportsman. Before his retirement he was a partner of Scott & Stringfellow, members of the N.Y. Stock Exchange.

I have recently learned of the death of **Frank Bodger** of Hollywood, Fla., on December 14 last year. Frank who operated a motel there was always an enthusiastic member of the class and a faithful attendant at reunions.—**Harold Bugbee**, Secretary, 702 Country Club Heights, Rehabilitation Way, Woburn, MA 01801

21

Well, here we are with another summer gone by and only eight months to our 65th reunion. Hope you all had a good summer.

A letter received in late May from **Helier Rodriguez** expresses regret that "Betty and I didn't get to Florida this past winter for another mini-reunion." Helier underwent major surgery in November, had a long recuperation at home with driving forbidden until January, and now is on a strict diet. He reports talking to **Claudia (Mrs. Josiah) Crosby** who said Josh gets about with a walker

and stays pretty much at home. Helier also phoned **Helen St. Laurent** who had a cataract operation. The operation was successful and Helen is now driving short distances. She planned to spend the summer in Center Lovell, Maine.

Sam Lunden phoned around the June 1 and followed up with a letter outlining plans for our 65th reunion gift to M.I.T. As of now it appears that that gift may amount to about \$3,000,000 which will be used to establish the Class of 1921 Scholarship Endowment Fund.

A long letter from class president **Carole Clarke** to all class officers and members of the reunion committee gave the present status of reunion plans. It has been decided not to have our reunion at Endicott House but to use the Hyatt Hotel near campus, which can provide more comfortable arrangements and a substantial reduction in transportation requirements. **Cac** and **Don Morse** sent me a list of those attending Technology Day events this year. At luncheon there were **Maxine** and **Cac Clarke**, **Helen St. Laurent**, **Irving Jakobson**, **Ed MacDonald**, **Frank Whelan**, **Bob Miller**, **Whitney Wetherell**, and **Leo Pelkus**. **Bob Miller** spent two weeks visiting **Whitney Wetherell** at his home on Cape Cod. He plans to do the same thing when our reunion rolls around next year. **Bob** tells me **Sam Lunden** arrived the end of June to spend the summer at his cottage on Cape Cod.

The Alumni Office has reports of four more deaths in our class: **Ernest S. Curtis**, West Palm Beach, Fla.—date unknown; **Trevor O.M. Davidson**, Milwaukee, Wisc.—date unknown; **Richard McKay**, Newton Center, Mass., on February 8, 1985; and **Donald W. Randolph**, Escondido, Calif., on April 16, 1985. . . . **Whit Wetherell** advises that **Henry Taintor's** wife, **Ola**, passed away last June 20 in Mission Viejo, Calif. **Henry** says that they had 61 happy years of marriage. The sympathy of the class is extended to their families.—**Sumner Hayward**, Secretary, Wellspring House E64, Wash. Ave. Ext., Albany, NY 11203; **Josiah D. Crosby**, Assistant Secretary, 3310 Sheffield Cir., Sarasota, FL 33579; **Samuel E. Lunden**, Assistant Secretary, 1149 S. Broadway, Suite B-800, Los Angeles, CA 90015

22

George Dandrow, **Oscar Horovitz**, **Ted Miller**, **Randy Myer**, and your secretary attended the Technology Day luncheon on June 7. **Marjorie Pierce's** absence (for the first time in years) was caused by unexpected car failure.

Don Carpenter's many friends will be glad to know that he is making slow but steady recovery from the stroke he suffered early in 1984. . . .

Martha Eiseman Munzer was introduced last winter to the Fort Lauderdale M.I.T. Club by **Oscar Horovitz**. At the last meeting of the season, she gave a talk ("Are Engineers Ecological Illiterates?"), which brought some lively responses from her audience. **Martha** has also been appointed to serve on the planning and zoning commission of Lauderdale by the Sea.

A note from **Milt Manshel** advises that he and **Ruth** are still enjoying comparatively good health with the expectation of another trip abroad. . . . **Theodore P. Shlikoff** writes, "I'm probably the oldest member of our class, 97 years old on May 29, 1985. Good luck to all." Our congratulations to **TPS** on his longevity.

The class has lost another illustrious alumnus: **William H. Mueser**, Course I, died in Charlottesville, Va. on June 25, 1985. He had been a long-time partner in the New York firm of **Moran, Proctor, Mueser**, and **Rutledge**, foundation engineers, and subsequently **Mueser-Rutledge**, consulting engineers. I think **Bill** attended every five-year reunion and many of the other alumni days. His wife, **Edna**, died some years ago. He is survived by two daughters and two sons.

James R. Morton, Course IX-B, died March 9, 1985 in the District of Columbia at age 90. He came to Tech as a sophomore after receiving a B.S. from Davidson College. He is survived by

his wife. . . . **Frederick A. Higgins**, Course XV, died April 20, 1984 at age 87 in Andover, Mass. He had been president and treasurer for many years of Central Construction Co. in Lawrence. He is survived by his daughter **Ann Higgins' Bride**. Our condolences are extended to the families of these classmates.—**Yardley Chittick**, Secretary, Box 390, Ossipee, NH 03864

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Don Moore's daughter, **Lick Observatory** astronomer at U.C.S.C., Prof. **Sandra Faber** has been elected to the National Academy of Sciences, becoming one of 48 women of 1,453 scientists since the national group established in 1863. The Academy advises in the form of reports, the most recent focusing on the effects of nuclear war and pollution of the ozone layer. **Sandy** has won the 1985 **Dannie Heineman Prize for Astrophysics** of \$5,000, which will be awarded at the joint American Institute of Physics-American Astronomical Society meeting in January, 1986. The citation reads: "By her spirited observational approach, **Sandra Faber** has much enriched our knowledge of the basic characteristics of galaxies. By the insight thus gained she has substantively advanced the theory of galaxy evolution." She is a consultant on NASA's 94-inch mirror telescope to be in orbit by August, 1986. She is also active in the development of the world's largest telescope, the Keck 10-meter, to be constructed in Hawaii.

Robert Bruce Lindsay passed away February 2, 1985 in the Newport, R.I., hospital. He gained his B.S. and M.S. in physics at Brown University and Ph.D. at the Institute. He was a distinguished scientist, educator, editor and administrator, and served as chairman of the advisory committee of the National Bureau of Standards. Named chairman of the Brown physics department in 1934, he became dean of the graduate school in 1966. In 1928, he shifted his research to theoretical studies of acoustics, and was advisor to the U.S. Navy on underwater sonar devices and to the U.S. Army on atmospheric sound-ranging equipment. He was a member of Phi Beta Kappa, a fellow of the American Academy of Arts and Sciences, a member of the Mathematical Society and the History of Science Society. He was a prolific writer of books and papers in the fields of physics, acoustics and philosophy of physics.

These notes were prepared without the assistance of my co-, **Dick**, who is in Greece, the land of olives and laurel wreaths. He verifies his presence by a picture post card of the Temple of Olympian Zeus in Athens. In front of it are a dozen or so of fluted marble columns supporting marble beams—no superstructure—apparently abandoned for lack of funds or workmen strikes.—Co-Secretaries: **Russ Ambach**, 216 St. Paul St., Brookline, MA 02146; **Dick Shea**, 7 Barkley St., South Yarmouth, MA 02664

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A successful 60th Reunion was assured when 36 classmates attended the activities planned. Wives accompanied 18 class members while five others brought guests to the reunion. In attendance were the following: **Linda** and **Gates Burrows**, **Mary Ann** and **Austin Cole**, **Mary** and **George Connard**, **Evelyn** and **Doc Foster**, **Ruth** and **Maurice Freeman**, **Marian** and **Franklin Fricker**, **Mary** and **Ed Harris**, **Ida** and **George Kohfeldt**, **Wei-Zing** and **Yu Ku**, **Adele** and **Ed Kussmaul**, **Grace** and **Stanley Lane**, **Kathryn** and **George McDaniel**, **Ila** and **Douglas Nettleton**, **Ruth** and **Arthur Odegard**, **Ruby** and **Rufus Palmer**, **Elinor** and **Sam Spiker**, **Billie** and **Don Taber** and **Evelyn** and **Karl Van Tassel**. Continuing, **Peg Murphy** was the guest of **Jim Howard**, **Harry King**, M.I.T. '53, was the guest of his father **Maxon King**, **Ed Lee** was accompanied by his son **E. Lee**, **Monroe Patch** had his daughter and son-in-law **Mr. and Mrs. Lomans** as guests and **Ben Oxnard**

was accompanied by **Mildred Hitch**. The others who attended were: **Willard Asbury**, **Henry Bevan**, **Harrison Browning**, **Arthur (Gus) Hall**, **William Herbert**, **Winthrop Humphrey**, **Don Jones**, **Masaru (Kamy) Kametani**, **Douglas Martin**, **Ed McLaughlin**, **Francis Mulcahy**, **Milt Salzman** and **William (Rick) Wheeler**. **Joe Martori**, the honorary member of our class, joined us on Saturday. **Joe** did yeoman service in planning and arranging for many of the reunion activities as he did for the other eleven reunions classes. Several other classmates who had planned to be at the reunion notified us finally that for various reasons they had to cancel out. They were as follows: **Ruth** and **Francis Foss**, **Eleanor** and **Fred Greer**, **Mary** and **Finley Lavery**, **Richard (Tom) Price**, **Carol** and **Max Sandfield** and **Mary** and **Alexander Ulmann**. You were greatly missed.

Although **Gates Burrows** and **Max King** came from the west coast, their mileage traveled was small compared with the distance **Kamy Kametani** flew to join us for the celebration. All were delighted that **Kamy** thought so much of the class that he made it to the reunion.

Classmates checked in during the afternoon of June 6 and were transported to the Stratton Student Center for a buffet and thence to Symphony Hall for the Pops Concert under the direction of **John Williams**. Friday, June 7, saw most everyone spending the day on campus for the Technology Day program beginning with breakfast at the Student Center, a memorial service at the chapel and followed by the activities of the day as outlined elsewhere in the *Review*. Our 60th Reunion class gift was announced as \$1,940,000. Dinner that evening was at the Hyatt. Special guests were **Bill Hecht**, '61, Executive Vice President of the Alumni Association and Professor and Mrs. **Irwin Sizer**. Dr. **Sizer** is President of the Whitaker Health Science Fund. After brief remarks by our guests **Milt Salzman** took charge of the program and presented the Outrageous River City All Stars, a most entertaining Barbershop Quartet. That group performed for nearly an hour providing comedy as well as songs and involved everyone in old songs familiar to all.

On Saturday, June 8, the program began with continental breakfast at the Hyatt. At 11 o'clock we were transported to Walker Memorial where we were served a regular New England clambake. Special guests on this occasion were President **Paul Gray**, '54, and Mrs. **Gray**. After a quiet afternoon there was a reception followed by dinner at the Hyatt. Dr. **James Killian**, '26, and his wife were our guests on the occasion as was **John Mattill**, editor-in-chief of the *Review*, and **Joe Martori**. Following dinner, **Sam Spiker** introduced **Jim Killian** and he talked briefly recalling some of the experiences about which he has written in his recent book, *The Education of a College President*. He answered a number of questions.

The reunion came to a close on Sunday, June 9, with brunch at the Hyatt.

It is with sorrow that the passing of several classmates must be reported. **William J. Mahoney** died at his home in Chatham, Mass., on June 12, 1985. **Bill** began his career in the oil industry with Cities Services Corp. before joining Automatic Comfort Inc. of Hartford, Conn. He worked for Automatic Comfort for 25 years, retiring in 1970 as president and chairman of the board.

The Connecticut Petroleum Association honored **Bill** with its Oil Man of the Year Award in 1965, and its Distinguished Service Award in 1970. **Bill** lived in West Hartford, Conn., for 35 years before moving to Chatham in 1971. He had been a summer resident here since his childhood.

He was active in the Red Cross and the United Fund while a Hartford resident. In Chatham he was a member of the Chatham Conservation Foundation, the M.I.T. Club of Cape Cod, the Chatham Retired Men's Association, the Chatham Historical Society, the Holy Redeemer Church, the Monomoy Yacht Club, and the Friends of the Chatham Council on Aging. He leaves a daughter, **Deborah Swenson** of Sudbury; three sisters, **Mary Griffith**, **Alice McCarthy** and **Frances Ham-**

mons, all of Chatham; three granddaughters and two great-granddaughters.

George L. Burns died in Portland, Ore., during the past year but the exact date is not available. **Frederic S. Jacques** passed away on March 12, 1985 in his home town of Bangor, Maine. Also, we are informed that the widow of **Sidney W. Andrews** died on January 25, 1985 in South Salem, N.Y.—**F. Leroy (Doc) Foster**, Secretary, 434 Old Comers Rd., P.O. Box 331, North Chatham, MA 02650

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Nathan Cohn has accepted the appointment by president **Bud Fisher** to be our 60th reunion chairman. **Ezra Stevens** is to serve as finance chairman and alumni association contact. Others on the reunion committee selected with various duties are **Dick Hawkins**, **Larry Day**, **Hal Edgerton**, **Russ Westerhoff**, **Bud Fisher** and **Joe Burley**. An initial meeting will have been held when this is published and we are confident of having a well-organized reunion.

I had a pleasant meeting with **Roger Nowland** and his wife **Linda** in East Blue Hill, Maine, where they live in a very attractive home. They designed and built it in 1972 on a ledge next to a tidal flow stream. The fascinating feature besides their picture windows overlooking Blue Hill Bay and Mt. Desert is a turret watchtower study. With a commanding view and a telescope, **Rog** can detect birds, boats (and pirates) among the islands.

Roger has been a consulting engineer in Greenwich, Conn., most of his life. The high point of his career was as a partner with **Norman Bel Geddes** who conceived the idea of the "City of the Future" for the New York World's Fair of 1939-40. General Motors had planned an auto assembly line for their exhibit but by persistent discussions with Messrs. **Sloan**, **Knudson**, **Kettering** and others their concept was accepted. **Bel Geddes** was the futuristic artist and **Roger** the practical engineer to design the complex's far-sighted highway system with moving vehicles in multi-lanes at different speeds.

The following is taken from May 15, 1939 *Life* magazine: "The General Motors exhibit was a smash hit because it put visitors in soft moving divans and rolled them up and down hill through a winding tunnel to show them the cities and highways of tomorrow." Picture caption said: "A 14-lane highway intersection of **Norman Bel Geddes'** huge Futurama in the \$5 million GM exhibit." The men who designed the Boston central artery should have seen this exhibit.

We had a nice visit with **Mary Houston**, widow of **George Houston**, in her lovely home in Camden, Maine above the outer harbor. She is a true '27er and sends regards to her friends in the Class. She would attend our reunion if some other widows would also. I would like to remind you that I was the proponent of wives at reunions and was roundly booed at our 25th.

Darcy A. Young Jr. died on November 24, 1984 in Peterborough, N.H. Through 1955 he and wife **Ruth** lived in Rochester, N.Y., and they retired to New Hampshire. . . . **Helmuth G.R. Schneider** died on February 25, 1985 in Westfield, N.J. He was a teacher at Newark College of Engineering. In 1955 he was laboratory head of Esso Standard Oil in Linden, N.J., one of the largest oil refineries.

Richard L. O'Donovan died on April 23, 1985 in Coral Gables, Fla. He was a Lt. Com. with the Seabees and was officer in charge of construction battalion maintenance in Bougainville improving roads, airfields, hospitals and utilities. This duty was followed by public works officer of naval facilities in Solomon Islands and Leyte.

An electrical engineer to his last day, **Dick's** final project was a new Burger King restaurant in Japan. His projects ranged from design of high voltage circuits for the Kennedy Space Center to the illumination of Viscaya Gardens. In his earlier

years he was involved in the electrical design of track-stations in the Bahamas. He was well known for his "Necklace of Pearls" lighting surrounding Miamarina. For over 30 years he belonged to the Florida Engineering Society and was past president of the Illuminating Engineering Society.

Our sympathy is extended to the widows and relatives of these classmates.—**Joseph C. Burley**, Secretary, RFD 3, Epping, NH 03042; **Lawrence B. Grew**, Assistant Secretary, 21 Yowago Ave., Norford, CT 06405; **Prentiss I. Cole**, Assistant Secretary, 2150 Webster St., Palo Alto, CA 94301

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At this stage of life we all tend to do some reminiscing, and so it has been with **Bill Hurst**. **Bill** recalls that he, **Charles Hall**, **Tom Larson**, and **John Russell** all graduated together as the four top students of their class at the old Mechanic Arts High School in Boston. The school building itself was torn down many years ago to make way for the Prudential Center. **Larson** and **Russell** are now deceased, and we have lost all track of **Charlie Hall**. Others of our class who prepared at that same old school were **Romeo Bossi**, **Arthur Elliot**, **Pete Kirwin**, **Paul Martini**, **Jim McCarthy**, **Roger Pursell**, **John Ryan**, and **Walter Smith**. Of this latter group only **Elliot**, **Martini**, **McCarthy** and **Smith** remain.

As usual our class made a very good showing at the 1985 alumni week activities in Cambridge. Those attending for all or part of the events were **Janet (Mrs. John Chamberlain) Sawyer**, **Frannie and Jim Donovan**, **Alleece (Mrs. Tom) Garrard**, **Bill Hall**, **Helen (Mrs. Robert) Harris**, **Janet and Fred Lewis**, **Mary (Mrs. Arthur) Nichols**, **Al Puschin**, **Florence and Walter Smith**, **Ann and Will Tibbetts**, and **Ruth and Abe Woolf**. We should mention in particular that **Alleece Garrard** made a special trip from McAlester, Okla. to attend the memorial service and to be with **Tom's** class for the Technology Day luncheon. After returning home she wrote a most gracious note to **Jim Donovan** in which she made special reference to the '28 50th reunion which she attended and enjoyed with **Tom** in 1978.

Ruth and George Bernat were in Boston in early June for the 50th reunion of her class at Simmons College and for the 25th reunion of their son's class at Harvard. . . . A note from **Charlie Worthen** tells us that they have moved from San Jose, Calif. to Santa Rosa, Calif. You may have his new address upon request.

With deep regret we must report the following class related deaths. **Walter R. Ramsauer** died May 11, 1984. **Walter** was in Course II, mechanical engineering, and was in engineering and management for most of his professional life. This included positions with General Motors, Young Radiator Co., The Garrett Corp. and The Signal Companies. He was responsible for many outstanding accomplishments, largely in the aircraft industry. His wife **Leta** survives him. Our record shows that they had a son and three grandchildren. . . . **Harold G. Nyman** died June 2, 1984. The information was provided by his wife, **Verna**. **Harold** graduated in Course VI, electrical engineering. . . . **Joseph D. Riley** died March 19, 1985. **Joe** graduated in Course VI-A, electrical engineering, and was in engineering and management for American Telephone and Telegraph Co. during his active years. He retired in 1968 and, with wife **Mary**, enjoyed much traveling, boating, and fishing. They have two sons, a daughter, and (we think) seven grandchildren. . . . **Alexander B. Daytz** died December 28, 1984. **Al** graduated in Course I, civil engineering, and his career was in engineering work. This included mostly structural work, consulting, and teaching (including M.I.T.) in his earlier years, then later as structural engineer for the State of California. He was also deeply interested in political, social, and economic problems. **Al** was widowed but leaves a son, a daughter, five grandchildren, and a great-

granddaughter. . . . We have news also that **Dora (Mrs. David) Mathoff** died earlier this year. Those who knew **Dave** will remember him as a devoted husband and a loyal classmate. To the families of these class associates we extend our sincerest sympathy.—**Walter J. Smith**, Secretary, 37 Dix St., Winchester, MA 01890

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As in 1980, our 55th Reunion was dampened to some extent, both literally and figuratively, by intermittent showers. However, the ratio of our athletic activities to our indoor activities has now dwindled to the point where inclement weather is rather less troublesome than at prior reunions. At total of 38 classmates and 31 wives attended one or more of the scheduled events, about 15 percent of our survivors. It seemed to me that the facilities at the Colonial Hilton in Lynnfield, where we sojourned, were well-suited to our needs; the planning of and arrangements made by **Joe Harrington** and his reunion committee worked out very well.

At the opening event on Wednesday evening we had a spacious room for cocktails, dinner and a slide show of prior reunions. During the day on Thursday most of those attending took the North Shore bus trip to visit points of interest in Marblehead, Salem and Gloucester. In the late afternoon we were transported to the M.I.T. Student Center for a buffet dinner and then to Symphony Hall for a Pops Concert. Dedicated "reunioners" will recall that the M.I.T. night at the Pops is always a reunion highlight. The many red jackets of the older alumni create a colorful scene and the program was well-chosen, less "stuffy" than five years ago. During the day on Friday we returned to M.I.T. for the usual Technology Day events. One item of special interest to the Class of '30 was the introduction of **Ching Yang**, who was accompanied by his wife **Sally**, as the alumnus who traveled the farthest to attend the Class Day luncheon.

In the evening the Class meeting and banquet were held back at the Hotel, with **George Wadsworth** presiding. **Dick Wilson** as chairman of the nominating committee presented a slate comprising **Ted Riehl** as the new class president and three incumbents: **Greg Smith** as class agent, **Ed Kingsley** as treasurer, and yours truly as secretary. Since **Ed** was unable to attend the dinner, **George** reported on his behalf that the class treasury is in good shape and no assessment will be required to cover reunion expenses. **Greg** told us that our contributions to the 1984 alumni fund totalled about \$80,000 and he expects the 1985 total to be about the same. After many years of being near the bottom of the giving range, our class is now somewhere near the mid-point of the range. In my "quarter-century" report as secretary I included a few figures from my records that may be of interest to those who did not get to the reunion. For example, of the approximately 500 members of our class who were awarded undergraduate degrees in 1930, some 247 were still living as of the date of the reunion. Slightly less than half of us have survived into our middle 70s. Over the last five years there have been an increasing number of new addresses containing both numbers and letters indicating a trend toward apartment and condo living. Also the number of classmates shuttling between summer and winter homes has increased. On the other hand 20 percent of us have refrained from selling the old homestead and have the same address we had 25 years ago. Half of us live in five states (Mass., Fla., Calif., N.Y., and Conn.); four percent live abroad and the rest are thinly distributed among quite a few states.

After the class meeting we enjoyed a very interesting slide-illustrated talk on the history, legends and myths of M.I.T. by **Marcia Conroy** who is on the staff of the M.I.T. Museum. A number of incidents of special interest to our class were mentioned and pictured: the student pranks per-

petrated in the late '20s, **Ernie Fell's** 1930 thesis entitled "Standardizing Cardinal and Grey Dyeings" which standardized the school colors, and the first "brass rat" class ring that **Ted Riehl** received as chairman of the ring committee in 1930 and donated to the Museum in 1980. The final event at mid-day on Saturday was a traditional shore dinner at an attractive seaside restaurant in Gloucester, which brought to a close a very pleasant 55th reunion.

It is unfortunately necessary to adjust the survivorship figure given in my reunion report. Two more obituary notices have arrived informing of the deaths of **Tom Hickey** on January 18 and **Hank Bates** on January 28, 1985. Tom spent his entire career at the U.S. Patent Office, first as a patent examiner and later in various supervisory jobs. At the time of his retirement in 1973 he was a "group director" in charge of all the examining divisions dealing with mechanical subject matter. He received a number of awards for superior performance, one of which was the Department of Commerce Silver Medal. He is survived by his wife Margaret, two sons and two grandchildren.

... **Hank Bates** spent his career working for Johns Manville, from which he retired as senior vice-president in 1972. Thereafter he and Helen established a retirement home in Los Altos, Calif., where they celebrated their 50th anniversary in '82 with Evelyn and **Dick Phillips** among the guests. From my records it appears that Hank attended every reunion except the 50th, which he missed for health reasons. He was an avid and able golfer. Thus the 30th reunion class notes record his "very respectable low gross of 88" and the March '61 notes refer to his treatment of "little white spheroids" at the Rockville Country Club in Rockville Center, L.I. where the Bates then lived. In addition to Helen, Hank is survived by two sons, two daughters, and 12 grandchildren.—**Gordon K. Lister**, Secretary, 294-B Heritage Village, Southbury, CT 06488

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When I was sick in the hospital, **John Swanton** took over the class notes and did a fine job. Thanks a lot, John. Thank goodness I seem to be well on the road to recovery now. Dr. **Henry B. Walker** writes, "still in active practice as an osteopathic physician in Nantucket. I have been an instructor in osteopathy in the cranial field since 1950, and went to England to teach the same in 1967 and 1968." Keep up the good work, Henry. ... A note from **John R. Gardner** says, "July 19, 1984—two weeks' photo workshop in Westport; April/May 1985—quicky trip to Sweden and Denmark. Weather: rain, snow and cold. ... **O. Mason Burrows** writes, "Kay and I took a trip up the Orinoco River (Venezuela) in February 1985. Also stopped at 12 of the islands in the West Indies. We also became Florida residents in December 1984, so it has been an eventful six months."

A letter from Roscoe "Doc" Smith, '23 tells of **Dan Connelly's** death and encloses a news clipping. The clipping reports that Dan owned a 40-foot boat, *Sea Gull*, and toured the waters of Ohio, Michigan, New York, and Canada until failing health forced him to stop about seven years ago.

Margaret Cullum reports that her husband, **A. Earl Cullum, Jr.** died January 31, 1985. On behalf of the class, I extend our sympathy to her.

—**Edwin S. Worden**, Secretary, P.O. Box 1241, Mount Dora, FL 32757; **Ben Steverman**, Assistant Secretary, 2 Pawtucket Rd., Plymouth, MA 02360; **John Swanton**, Assistant Secretary, Rt. 2, Box 2310, Wiscasset, ME 04578

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Technology Day, June 7, was a lovely day. Our classmates that attended were **William Bannon**, **John Brown**, **Don Brookfield**, **Melvin Castleman**, **George Kerisher**, **Robert Lobban**, **Douglas**

Miller, **Robert Minot**, **Thomas Weston**, and **Don Whiston**.

Most of us attended a class meeting called by our president **Don Brookfield**. Our mini-reunion in Sarasota, Fla., was reviewed and proclaimed a success. Some preliminary thoughts were given to our 55th reunion. Several plans for a proper tribute for **Ed Nealand** who had done so much for our class. A final plan will be announced soon.

John Brown was elected assistant treasurer. **Robert Minot** was elected assistant secretary.

During the day there was a memorial service for M.I.T. alumni reported deceased from May 1, 1984 - May 2, 1985. The 15 members of our class who were remembered are as follows: **Earl F. Anderson**, **George E. Colby**, **John F. Crowther**, **Lucien B. Curtis**, **Bertil A. Franson**, **Mrs. Don N. Higgins, Jr.**, **J. Alan MacDonnell**, **Oliver Morfit**, **G. Edward Nealand**, **E. Allen Newcomb**, **Gerner A. Olsen**, **George W. Palmer**, **H. Arthur Phillips**, **Joseph Santoro**, **Sterling N. Slockbower**, and **Joseph Welch, Jr.**

Katherine S. Burrows writes us a very nice letter. She and her husband Mason live in Englewood, Fla., and spent the summer in Massachusetts. They regret not being able to attend the mini-reunion because they were taking a cruise through the West Indies and up the Orinoco River in Venezuela to the Angel Falls.

Commander **Leo T. Tyburski** USN (Ret.) attended his ship's annual reunion in Chicago. He writes, "Funny how they all changed since 1942. Had to be introduced to practically all of them!"

Colonel **William Glowa** and his wife Mary answered our class holiday greetings with the poem "Christmas in Falls Church, Va." which describes what is going on in the Glowa family. The highlights of what seemed a happy and productive year were the births of two grandchildren, **Katheryn Michelle** and **Robinson William**, a fast arrival who was "almost born in a pumpkin patch cluster." Their garden brought forth dahlias and the gladiolas as well as a bountiful harvest which was canned. "Bill is still steady-at-the-helm as we wish you all a Merry Christmas in your realm."

Thomas Hannafin tells us he lost his wife in 1977. He is in good health. He likes to walk and drive. He has four children and six grandchildren.

... **Rolf Morral** and his wife **Lillie** have just spent eight weeks travelling in Europe (they covered 16,000 miles). He lectured three times in Barcelona and received an "Off the Press" volume two of his book *Metalurgia General*, co-authored with Dr. P. Molera. ... **George W. Palmer** a retired army colonel died in December 1984 in a Portland, Maine, hospital at age 83. A West Point graduate, his career was devoted to the Army. He held many positions of responsibility in the foreign service as well as domestic. He leaves a son, a daughter, and four grandchildren.—**Melvin Castleman**, Secretary, 163 Beach Bluff Ave., Swampscott, MA 01907

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We have only a little news of Technology Day 1985 at Cambridge. Col. **Len Julian** wrote that he enjoyed Alumni Day and saw the **Ed Simpsons** and the **Ralph Crosses** on campus and other old friends, one of whom he last saw in Germany 30 years ago.

Don Severance, '38, who is in resource development for M.I.T. wrote us that he took **Lucy** (Mrs. **George Henning**) and one of her daughters to the memorial service and saw **John Longley** there. Don suggests that we might invite the ladies of our deceased members to our next reunion.

Some of us grow older and like the less active life and some of us remain active in many fields. **Walter Skees** who lives in Barcelona for instance sent a copy of his new license to fly single engine planes. He would welcome a direct phone call 343/329-8543. ... **Mal Mayer** was back in mainland China again in the summer. He sent **Warren Henderson** and secretary **Beau** postcards from Pe-

king. ... **Horace Mackenchnie** sends word that he has retired and remains very busy in community and family affairs. ... **Richard Gorman, Jr.** has received 50-year certificates of membership in the American Chemical Society and in the Institute of Chemical Engineers.

The *Review* lists deceased alumni before the Class Notes, so we may not carry their names every time.

George Stoll writes that he remembers **Frank Hatch** from Theta Chi. He reports that they are having **Ann** and **Fred Murphy** join them for landlocked salmon for supper in mid-summer. He and Jane were headed for Alaska in early summer, flying up and cruising back. **Fred Murphy** went to Bermuda for "our annual trip to Bermuda to regain our lost youth." ... We used to hear from **Dot** and **Bill Huston** once or twice a year. He should write again. How about some of you who haven't written in ten years trying it again. ... **Bob Wellwood** sends us a resume of his career, but it was written in 1965. ... better late than never, I suppose! He's the man who said he had no ditto marks in his career. Boy, was he ever a busy fellow!—**Beau Whitton**, Secretary, Cottage 112, Sharon Towers, 5150 Sharon Rd., Charlotte, NC 28210

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Our losses continue, although at a moderate level. This month I have two to report. The first is **Robert N. Eck**, who died in Brookfield, WI on March 29, 1985. I have no information about his career but the 1975 *Alumni Register* lists him as manager of product standards and manufacturing safety at Cutler Hammer. Our other loss is Dr.

Walter Hedeman, Jr., who passed away on April 14, 1985. This is a little closer to home, as Walt had been part of the group I was close to when we were in school. Again, I have no information about him; the 1984 *Register* shows him living in Annapolis, Md. (where he died) but with still some business connection to the Aerospace Corp. in San Bernardino, Calif. To both families I express the sympathy of the class on their loss.

There is one Alumni Fund note—from **Maxwell N. McKeand**. He writes, "Retired and living in West Melbourne, Fla. with wife **Katherine**. Golfing is taking the place of yachting. We enjoy the Florida sun and warmth—even in the summer."

Several times in this column I have mentioned **Wing Lem Wu**, our classmate who is still teaching aerodynamics at Beijing Institute of Aeronautics and Astronautics. Those who were at last year's 50th reunion will remember that Wing had sent a small tapestry to the class. Last winter at a dinner in Cambridge, **Norm Krim** mentioned that he and **Bea** were planning a spring trip to China. Both **Walt Wrigley** and I urged him to look up Wing, and Norm did the necessary spadework to make the contact possible. When he left, he had with him one of the 50th reunion pictures, with some of Wing's college friends identified, and one of the 50-year souvenir books.

All of this comes from a great letter from Norm, who also included a photo that was taken the evening they had with Wing at the Great Wall Hotel. Norm says that during this time he and **Bea** received quite a good account of many of the events between the time that Wing returned to China in 1935 and their dinner meeting. He, and later his wife and three children, lived through the Japanese invasion, the Revolution of 1949, the Cultural Revolution of 1966-1976, and all the recent changes. As Norm says, "Wing made it—he's a survivor!" As the picture shows, he is in good shape. Wing and his family live on the Institute grounds about ten miles from the Great Wall Hotel. He is still working as a full-time professor and is an expert on wind tunnels. His professional skills are still in demand, partly because the colleges, including his, were closed to students during the ten years of the Cultural Revolution; thus there is a shortage of aeronautical engineers.



Bea and Norm Krim, '34 (left) join Wing Lem Wu, '34, at the Great Wall Hotel on their recent visit to China. Wing Lem Wu, survivor of the Japanese invasion and two revolutions, is professor of aerodynamics at Beijing Institute of Aeronautics and Astronautics.

Norm and Bea's trip with Linblad took them to Xian from Beijing, where they saw the 6,000 clay life-size soldiers, then to Chungking, where they boarded the *M.S. Bosham*, their luxury home on the Yangtze for a week. They visited the scenic Three Gorges, ran "white water" in the three small gorges in a sampan, with water moving at 25 miles per hour! The tour made a visit to the new giant Eezhouba Dam project, which is currently generating 5,000 megawatts of hydro power; when it is completed in a few years it will have an output of 13,000 megawatts, which they claim will make it No. 1 in the world, followed closely by Itaipu in Brazil.

They disembarked at Wunan, flew to Shanghai, then on to Hong Kong and home. It sounds like a wonderful trip but I would hope that a major highlight was the visit with Wing, reminding him that he is still in our thoughts.—**Robert M. Franklin**, Secretary, P.O. Box 1147 (620 Satucket Rd.) Brewster, MA 02631; **George G. Bull**, Assistant Secretary, 4601 N. Park Ave., Apt. 711, Chevy Chase, MD 20815

35

Well it finally happened! Our 50th Reunion was the superspecial happening that we had all been looking forward to. With the help of many inspired hard-working committee classmates, more than two dozen devoted Alumni Association and M.I.T. service personnel, and most of all, 110 classmates who came accompanied by 78 spouses and friends conspired to put on an affair which all of us will remember the rest of our lives. In fact the only losers were those, who for one reason or another, were unable to attend. For you I shall endeavor to hit the high-lights to start whetting your appetite for our 55th, and for the rest of us to savor happy memories once more.

I had the fun task of being one of the "greeters" at McCormick Hall Wednesday June 5th during registration, along with **Leo Beckwith** and **Chet Bond**. The decimal count rose steadily in the lobby from 1:30 on as we were inundated with new arrivals who, after checking in and settling into their rooms, returned to the lobby to join in the welcome. Buses took the 200 of us including guests to the M.I.T. Museum where director Warren Seamans, our honorary classmate, hosted a cocktail party prior to our return to McCormick Hall for dinner and entertainment by the M.I.T. Chorallaries. Thursday after breakfast the 1935 crew took a couple of half-mile practice runs much to the delight of those who rowed and of classmates and wives with cameras. The oarsmen included: **Leo Dee**, **Will Grosser**, **Charlie Debes**,

Bob Olsen, **Whit Stueck**, **Don Wood**, **Walt Stockmayer**, **Art Haskins** and **Allan Mowatt**. **Larry Stein**, '34, was our coxswain and **Art King** helped us get the shell in and out of the boathouse and river with assorted undergraduates. **Pete Holland**, M.I.T. Crew Coach, supervised the operation and gave each of us a grey T-shirt with enormous cardinal T on the back! Several bus loads went in town to the Faneuil Hall marketplace for browsing and lunch and returned in time for the Class picture taken on Walker's front steps before moving on to the President's reception at his house and dinner at Walker Memorial with President and Mrs. Paul Gray. The Boston Pops with John Williams conducting was its usual enervating and ebullient self. It was fun to see all those red-coated '35ers in attendance. Technology Day, Friday June 7th, reached a climax for us when **John Taplin**, Chairman of our 50th Reunion Gift Committee made his presentation at the Alumni luncheon of 1,200 alumni in the Athletic Center. He proudly announced our gift of \$3.75 million (since grown to over \$4 million) and a class participation of 96 percent (since grown to 97.5 percent). Both of these accomplishments set new records of achievement for 50th reunion classes. To fully appreciate what **John Taplin**, his committee and our class has done, note that in past years, except in 1984, the class participation in the gift has been in the 60 to 70 percent range. The Class of 1934 set a new record last year of 74 percent. We had made up our mind to aim for 100 percent and a record that no other class could exceed. The announcement of 96 percent sent a collective gasp among the 1,200 at the luncheon. Congratulations go to just about every one of us and especially to **John Taplin** for the time and energy he put into making that achievement possible.

That Friday afternoon we set off for the Cape and Wianno where we started again with a cocktail party and dinner that evening where socializing was the word. Saturday was showery but not as wet as five years ago for 18 played golf, the tennis courts were busy as were two bridge tables and two hardy souls who went in for a swim in the ocean. A putting contest kept a large group busy during a rain stoppage in mid-afternoon. Then there was the lobster and clambake dinner with dance music and awarding of prizes to the winners of the various activities.

Sunday morning about 100 of us gathered after breakfast for our class business meeting with the election of officers to serve the next five years the chief objective. **Leo Beckwith**, chairman of the nominating committee which included **Hal Bemis** and **Allan Mowatt**, presented the following slate which was accepted, nominated and elected: president **Bernard H. Nelson**, vice-president **J. Goffe Benson**, vice-president **John F. Taplin**, vice-president and treasurer **Randolph Antonsen**, assistant treasurer **Phoenix N. Dangel**, class agent **Hal L. Bemis**, estate secretary **Leo M. Beckwith**; area vice-presidents: Maine, **Dexter J. Clough II**; northern N.H. and Vt., **Walter H. Stockmayer**; southern N.H., Vt., and western Mass., **Bissell Alderman**; eastern Mass., **Edward J. Collins**; Rhode Island, **Ellis M. Flink**; upstate N.Y., Westchester and Fairfield counties, **J. Goffe Benson**; New York City and Long Island, **E. Donald Gittens**; New Jersey, **Henry J. Ogorzaly**; Penn. and Delaware, **Philip P. Johnston**; Maryland and Wash. D.C., **Edward J. Taubman**; southeast central, **Randolph Antonsen**; Florida east coast, **Leo H. Dee**; Florida west coast, **Wesley H. Loomis III**; midwest-north, **William W. Cross**; midwest-central, **Charles N. Debes**; southwest, **W. Earl Peterson**; northwest, **John B. Ballard**; California, **Charles A. Piper**. It was pointed out that **Allan Q. Mowatt** had been elected permanent secretary at our last meeting and needed no further nomination. **Leo Beckwith** then read the following to the meeting: "Finally, I think we're all aware that the extraordinary turnout and quality of this Reunion is due to one man and his quiet and inspirational leadership with the wonderful help of Rhoda. We've watched **Bernie Nelson** spend the

last five years in constant touch with innumerable classmates, promoting, planning and organizing for the Reunion and for all the other class interests. Therefore, the nominating committee is happy to suggest that **Bernard H. Nelson** be elected as Permanent Class President." In the up-roar of approval that followed **Bernie** took over the microphone and told us he would be happy to be President for the next five years but did not feel it was appropriate to elect a permanent President at this time. **Lars Ekwurzel** was recognized and read the following note from **Priscilla, Jack Colby's** widow: "Greetings to the Class of '35. Thank you for your special invitation to attend the 50th Reunion. As I said to Lars, M.I.T. gatherings were so personally Jack's that I would prefer to remember them as they were, shared by the two of us. He treasured his college years and the friends he made. Have a great time—good health and good luck to everyone." The meeting was then adjourned.

The only remarks that could be considered to be in any way negative about the reunion were stated by a number of classmates who said in effect: "I wish more classmates had been there, especially old friends that I had been looking forward to seeing." This is a lesson for each of us to keep in mind for the next reunion/s. Let us get in touch with those we want to see again, now, and let them know. If you need addresses or phone numbers let me know. If you give me permission I shall include right in these notes that "So-in-so is looking for U-no-who."

Here's a note from **Bob Forster** explaining why he couldn't be there and sending his and **Connie's** thanks for the card we sent: "Thanks for your call the other day. The day before, I had received an envelope from **Bernie** containing the Reunion booklet, schedule and list of attendees plus a card signed by many. Both **Connie** and I appreciate this very much. Actually I spent June 5 from 7:30 p.m. till June 13 in Newton-Wellesley Hospital. So while you enjoyed the reunion I looked at nurses, IV's, blood tests, xray, sound scans, you name it. The verdict: heart O.K., all things normal except for asthma and a touch of pneumonia. I am much better but have a way to go. The reunion from what I received appears to have been quite successful for which I am glad. The guiding group did a good job. **Connie** and I regret our inability to attend. I would like you to express our appreciation of their thoughtfulness in remembering us by means of the class notes. Our very best, **Connie** and **Bob**."

I am already away over my allotted space so I will include in the next class notes letters from **Walt Stockmayer**, **Frank Hatch** and **Chet Bond**, notes from **Alfred Greenlaw** and **Copeland Macallister** and short "human interest" notes from **Hank Ogorzaly** and a matching one from me!—**Allan Q. Mowatt**, Secretary, P.O. Box 524, Waltham, MA 02254 (617) 899-0358

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Luncheon on Alumni Day brought **Kitty** and **Herb Bordon**, Virginia and **Augie Mackro**, **Vince Estabrook**, **Frank Phillips**, **Louis Stahl**, and your secretary together at the table. The Pops the evening before was attended by **Rosalie** and **Jack Chapper**, and **Rose** and **Ed Dashevsky** and, I assume, also **Herb Metten** who was listed as an attendee. **Larry Peterson** was listed as planning to attend but his presence was not reported to me. **Frank Phillips** was east briefly and reported that he and **Phebe** are house hunting in Santa Fe.

Most of the other news this time is less happy. **Charlie Saffer** wrote to report the death on May 9 of his brother-in-law, **Joseph Ackerman**. Joe received his S.B., S.M. and Ph.D. from the Institute and began his career with **Kimberly Clark Corp.** in Wisconsin as a research chemist. During World War II he was associated with **National Fireworks, Inc.** and afterwards with **Phillips Petroleum**. From 1970 to 1984 he taught chemistry at **Malden High School**. He is survived by his wife,

Lucille, a son, daughter and four grandchildren. According to Charlie, Joe had suffered several heart attacks in recent years. I have written to Lucille at 35 Hodge Rd., Arlington, MA 02174 expressing our sympathy.

A note from **Herb Metten** reported the death on May 24 of **William Peter Toorks** in West Yarmouth, MA 02673. Through the years he had worked for Ardwin Micro Labs, Sylvania and Microwave Associates in Massachusetts. He is survived by his wife Regina (38 Wilson Rd., West Yarmouth) and a daughter and a son. I have also written to Mrs. Toorks. . . . In answer to the *Interest Finder* for the 50th, mailed in June, I received a note from Betty Morgan telling that her husband, **Paul S. Morgan** had died in May. She wrote: "He had been ill for several years and I am sorry to say that his retirement was none too pleasurable in spite of our move to such a beautiful community (Naples, Fla.). However on a note of cheer, a new grandson, Paul Morgan II was born on May 31; a future candidate for M.I.T. Class of 2003!" Paul was retired from the Pacific Pumps Division of Dresser Industries where he had been a sales engineer. I have written to Betty Morgan at 4650 Chippendale Dr., Naples, FL 33962.

And now a reminder. Have you sent in your biographical questionnaire? Do you need a fresh one? Just let me know and I'll send one off to you. By the time you read this we may have set a deadline for the due date. You will be directly informed. By the next issue I will have a list of classmates who hope to attend our reunion. Meanwhile, if you can find your way clear to travel to West Hartland on October 26 do get in touch with me.—**Alice H. Kimball**, Secretary, P.O. Box 31, West Hartland, CT 06091

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Winthrop D. Comley, of Hampton Falls, N.H. retired January 1, 1985 as a consultant with Stone and Webster Eng. Corp. He writes, "We have moved into a new retirement home with five acres of producing apple trees. Keep busy outdoors and part-time consulting. We live about six miles from 'Hobby' Hobson, who lives in Rye, N.H." . . . **Joseph S. Dunning**, Los Angeles, Calif., retired in November 1979 from McDonnell Douglas Co., Inc., as vice president, administration and is now self-employed doing consulting. Joe writes, "Hobbies and volunteer work are United Way, church, board of directors for Long Beach Community Hospital, golf and photography. Travels include Panama Canal Cruise, Spain and Morocco, Hawaii, Mexico, and Canada. Wife Vivian's main interest is L.A. County Museum of Art." . . . **Frank E. Goddard, Jr.**, Altadena, Calif., retired in May 1977 from Caltech, Jet Propulsion Laboratory as assistant director for R&D. He is the recipient of the NASA Exceptional Service Medal. Frank's hobbies are travel, golf, swimming, "grandson," family and ancient history. Travels include Turkey and the Soviet Union for three months in 1980; cross-country and back by car; New England; British Columbia; Egypt; Lithuania; Latvia, and Estonia. Wife Irene's main interest is writing. Frank's daughter, Daiva Brown, has one son, Adam. Son Stephen has no children.

Albert Shulman, Hartford, Conn., hopes to retire soon. He is self-employed, managing his own real estate, and also classifies himself as a farmer managing a 400-acre farm in Vermont. Albert reports his awards as "blessed by the good lord with a wonderful family, good health, and friends." Travels include France (1973), Switzerland (1975), China (1976), Hong Kong, Thailand, Bali (1979), England (1982), Hawaii (1968), Israel (1984), and Caribbean British Virgins. Wife Rachel's main interests are art and family. Children are Marc, Justine, Amy, Sally; grands, Laura, Matthew, Andrew, Nicholas, Stephanie, Boyd, Aron, Rosie, and Samuel. . . . **G. Richard Young**, Newport, R.I., writes, "Marge and I spent a few

days at The Tides Inn, Irvington, Va. over the Memorial Day weekend and while there had a pleasant time at the home of Betsy and Jack Robbins, who live in small community of Whitestone, which is next to Irvington. They retired there ten years ago from New Jersey, where he spent almost all of his career with American Cyanamid. They are very happy, healthy, vigorous (unbelievably so) and active in all of the affairs of the complete American couple. As we went about the area with them, they seemed to know everybody by first name. Jack has a big motor boat, a good old solid one made for moving all around the Rappahannock and lower Chesapeake waters. He used it to pick up Marge and me at The Tides and take us up a branch of the cove to their waterside home. Some taxi service! Dinner with them at their club, golf the next day, and then luncheon with us at the newer of The Tide's golf clubhouses gave us all a chance to talk over old times. We last saw each other at our '10th.' We'll see them again next year, or sooner if they come up to New England. Fairly soon now I'll be in touch with **Bob Thorson** and the others to meet for our 50th preparation. We have Wequassett Inn lined up. It's in Pleasant Bay, Chatham. Its expansion makes it perfect for our large group."

I regret to report the deaths of **Robert L. Alder** on April 6, 1985 (last address, 2302 Country Club Pkwy., Garland, TX 75041); **Leslie A. Johnson** on April 20, 1985 (last address, P.O. Box 2371, Jonesboro Heights, Sanford, NC 27330); and **George A. Randall** of Newburyport, Mass on June 17, 1985. Gerry Jackson, daughter of George Randall reports from 3320 Bonnie Brook, Plano, TX 75075 that George died of a heart ailment. He had returned from China about three weeks previously, where he square danced on the Great Wall of China. He was the father of George A. Randall, Jr., '66 and father-in-law of Bill Jackson, '62. In 1984, George earned his life master in bridge!—**Lester M. Klashman**, Assistant Secretary, 289 Elm St., Apt. 71, Medford, MA 02155; **Robert H. Thorson**, Secretary, 506 Riverside Ave., Medford, MA 02155

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June 7 marked another successful mini-reunion at Endicott House in Dedham. Among those present were Ruth and **Paul Black**, honorary classmate **Diana and Hugh Darden**, Madelyn and **Paul Des Jardins**, E. and **Frank Gardner**, Ina and **Haskell Gordon**, Jean and **Ed Hadley**, Alice and **Roy Hopgood**, Pat and **Bob Johnson**, Sylvia and **Sol Kaufman**, Muriel and **Norm Leventhal**, Y.T. Li, Gerry and **Dave Morse**, Marie and **Paul O'Connell**, **Harry Saunders**, Hope and **Phil Sellers**, Phyl and **Don Severance**, **Dick Vincens**, Nancy and **Dave Wadleigh**, and Carol and **Al Wilson**. A good time was enjoyed by all; why don't you test the waters for yourself and plan to attend in June 1986? Plans continue to roll for '38 in '88. Class president **Don Severance** announced that **Horace Homer** volunteered (?) to edit our 50th year class book. Horace, who lives at 702 Quaker Rd., North Falmouth, MA 02556, welcomes your suggestions and, more importantly, pictures and reproducible memorabilia from our freshman and senior years and from our various class reunions.

John Craig, retired from the Bell System, keeps busy in community service in Woodbridge, Conn., where he has put in four years as a selectman. . . . **Ascher Shapiro** gave talks this spring to the M.I.T. Clubs of Northern California and Southern California. Subject: research at M.I.T. on an improved method for preventing deep vein thrombosis.

I am sorry to report that **Alfred Sweeney** passed away last December. He had been living in Santa Barbara, Calif. . . . **Wilber Haynes**, who had lived in Kissimmee, Fla. also passed away. No further details are available.—**Armand L. Brueneau, Jr.**, Secretary, 663 Riverview Dr., Chatham, MA 02633

40

The 45th reunion has come and gone. I am sure all who attended, both at M.I.T. and Woodstock, can say it was an enjoyable, unforgettable affair. Some statistics: 59 attended M.I.T., 109 including spouses, etc.; 46 went to Woodstock, 90 including spouses, etc.; 67 of the alumni attended one or the other - this is somewhat higher than other 45th reunion classes.

The Thursday morning breakfast at the Hyatt Regency, trip to Boston Museum of Fine Arts and new Copley Place during the day, Pre-Pops Buffet at the Student Center, and then the M.I.T. night at the Pops with John Williams conducting, made an active and enjoyable day for all. A fascinating and informative session on recent breakthroughs in the world of cellulose and sub-cellulose biology was presented by a distinguished panel at Kresge Auditorium on Friday morning. Following this Technology Day luncheon and off to Woodstock.

Business meeting and elections were held at Woodstock Saturday morning with **Jim Baird** assuming the presidency and **Ed Bernard** and "yours truly," remaining as treasurer and secretary, respectively. Jim Baird voiced the appreciation of all for the fine work done by the reunion committee to make this reunion a success and an M.I.T. pen was presented to each member. Jim also indicated that there was a surplus of travel bags and L.C.D. clocks. They are still available at \$10 each - first come - first served!

Class acknowledgement was given to **Marshall McCuen** for his 30 years of service on the Educational Council for which he received the M.I.T. George B. Morgan award.

Ed Bernard indicated that the class treasury has approximately \$15,000 prior to paying reunion bills. Question was raised as to what to do with funds remaining.

Discussion centered around the 50th reunion, which is held on the campus. It was voted to have an extension of the reunion away from the campus after the M.I.T. ceremonies. A campaign chairman will have to be selected in the near future for the 50th fund raising activities.

Sally Bittenbender opened the seminar by classmates on "Life after 65" by reading a series of rhymes she had composed for this "senior group," which were humorous, elegant and refreshing. Space does not allow them to be published in this issue - but certainly I will see that it appears in a future publication.

Marion Wright told how Gary, although he has been on dialysis for several years, has been able to travel and to attend this reunion, including Woodstock, even though he had to travel to Burlington, Vt., Saturday morning for treatment.

Ed Bernard gave an interesting talk on National Executive Service Corp. It is a volunteer service for retired executives who would like to contribute their talent to various organizations, (non-profit groups, small businesses and government units) to improve their management and the effectiveness of their operations. Ed has been quite active with this group.

Charlie Edwards gave a fascinating talk on the family winery which he became involved in after his retirement from Bendix Corp. (see Feb./Mar. notes). The Merry Vintners is the name chosen for the winery as well as the label. Cases of wine are now for sale (The Merry Vintners 1984 Vintage Preview Chardonnay) on a first-come basis.

. . . **D.J. Edwards** also described her church activities as a dancer and choreographer.

Norm Klivans, who is still active as a management consultant, indicated that he had suffered from back problems until his doctor suggested an exercise program. These exercises eventually eliminate most of his difficulties allowing him to continue with golf.

Andy Kay presented his entrepreneurial activities from 1953, when he started Non-Linear Systems, Inc. in Del Mar, Calif., manufacturing digital multi-meters, until 1982 when they entered the micro-processor and computer fields with

sales soaring to \$125 million in 1983. Andy's father, who is now 89, is still active in the company.

Al Gutttag, although not retired from Cushman, Darby & Cushman, is slowing down gradually on his patent attorney activities. Jogging and stamp collecting also keep him active. . . . **Dave Morgenthaler**, at age 48, sold out his interest in a business he had started, since he felt it offered no future challenges, and started a venture capital business, based in Cleveland, Ohio, called Morgenthaler Associates. He has had all types of challenges and opportunities in this type of business. . . . **Rowland Peak** outlined his activities since retiring from the Illinois Central Gulf Railroad in 1979 - consulting with industrial plants and railroads having tracks and equipment to build and maintain.

Frank Penn has been an active member of the Planning Board in Darien, Conn. He outlined many of the interesting problems he is faced with on this board as a resident of the town. . . . **Bart Weller**, board chairman of Vitramon, explained his work on the Weller-World Watch which he developed with the assistance of your class secretary. Bart's international business, coupled with his experience as a pilot, prompted the development. The unusual 24-hour dial remains at the 24-hour world time. It displays correct time for each person wherever he may be located.

Golf, tennis, town of Woodstock sight-seeing, a Woodstock High School Alumni parade, etc., occupied the remaining portion of Saturday until the evening, when a luscious lobster/steak/clambake was held at the Golf Clubhouse. Slides of past reunions, song fest, etc. climaxed this affair.

I received the sad news that **J. Herbert Hollomon**, of Brookline, Mass., died on Wednesday, May 8, after suffering a heart attack in Albany. He was returning from Chicago, where he had been honored by Bell and Howell Co. for his service as a company director. Dr. Hollomon was president of the University of Oklahoma from 1968 to 1970. At the time of his death, he was director of the Boston University Center for Technology and Policy, which he established there in 1983. Herb joined the General Electric Co. and later became general manager of its General Engineering Laboratory. He was assistant secretary of commerce for science and technology during the Kennedy and Johnson administrations and was named assistant undersecretary in 1967. His government service also included positions on the President's Science Advisory Committee, the Federal Council for Science and Technology, the President's Advisory Group on Contribution of Technology to Economic Strength and many others. He joined the M.I.T. faculty as a consultant to its president in 1972 and established its Center for Policy Alternatives. He held the Japan Steel Industry Professorship at the same time. Dr. Hollomon was a founding member of the National Academy of Engineering and a Fellow of the American Association for the Advancement of Science. He leaves his wife Nancy, four sons and a daughter.

Although I have many more interesting items to cover, I will close this issue with one that brought immediate attention and response: an alumni note squib which I wrote for the May/June issue about **Hal Davis** wasn't so. Has no wife, never been a Harvard student, bladder is "A-OK" and always has been, and still pretty healthy. Hal says fret not, all is forgiven - will try to make the 50th. Unfortunately, the notes I got from Jim Baird regarding those who could not attend the 45th reunion, got tangled. The information was about **George E.B. Hill**, who is retired and has his home in Kentfield, Calif. All for now—**Donald R. Erb**, Secretary, 10 Sherbrooke Dr., Dover, MA 02030, (617) 785-0540

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We have been informed of the death of **Floyd W. Iden**. Floyd was a consultant for the Avionics Di-

vision of International Tel & Tel Corp. . . . **Albert H. Riehl** has retired from Abbot Laboratories in North Chicago and has moved to Maryland where he enjoys his loafing. We need a new address from you Al. . . . **Albert L. Bensusan** also has retired and has three grandchildren. He may come to next years reunion, but asks "What is a slide-rule?" Oh well, a sign of the times. . . . **Col. Joseph M. Bird** lives in Potomac, Md., has been traveling in Australia and New Zealand and will attend the reunion. . . . **Paul M. Bishop** lives in Dallas and has retired from the Advanced Reactor Div. of the Westinghouse Electric Corp. He likes the Caribbean and has two grandsons and one granddaughter. He cannot attend our reunion.

William L. Babcock has retired from Hercules Inc. He has spent four weeks in Hawaii this spring and we may see him next year. . . . **Edward A. Beaupree** sends us a most interesting letter with this information. He has six grandchildren; his first born daughter Roberta died December, 1984, his youngest son died in 1979, aged 32. Ed goes to Florida in winter, where he sees **Zack Abusa**, and spends his summers in Maine. Ed and his wife enjoy squaredancing and still love to play cards. Ed has finally hung up his hockey skates, he complains that there are not enough hours in a day, so what has changed? I am sure we will see Ed next year. . . . The Class of '41 has another immortal. ZPG presented its first **Les Corsa** Endowment Fund Award. **Leslie Corsa**, M.D., a pioneer in population planning, died in 1984. He had devoted his life studying world wide population problems. . . . It has come to our attention that **Richard Herman Gould**, Chief Engineer of Switch Prod. Anderson Power Products, Newton Center, Mass., has died.—**Joseph E. Dietzgen**, Secretary, Box 790, Cotuit, MA 02635

42

Surely haven't been earning my secretarial pay lately with no column for the last two issues due to, not a dearth, but a total lack of news. Things have picked up only slightly. And too much in the Obit Department.

A notice from the Alumni Fund tells that **Bob Boyer** died last December in Manchester, Tenn. . . . **Ray Wyland** passed away in Tunjuna, Calif., in April. Ray was a very talented classmate with many activities. He came from Scarsdale but migrated to the West Coast after World War II. He was active in Cross Country, worked on *Technique* and was general manager of the M.I.T. Musical Clubs. In June, **Dan Hulett** died in Stamford, Conn. He graduated from Course X and spent his entire career with Union Carbide. Dan had many interests, he was an avid amateur photographer, was active in the American Institute of Chemical Engineers and was an ordained elder and a deacon of the First Presbyterian Church of Stamford. Sincere sympathy to Phoebe Wyland, Sara Hulett and the families.

George Toumanoff retired from his position as vice-president for radar and navigational systems at Eaton Corp. on January 1. He has signed on to run a volunteer program at the Target Rock National Wildlife Refuge of the U.S. Fish and Wildlife Service and was elected president of the International Measurements Conference for the next three years. Their headquarters are in Budapest so we are expecting some travelogue type letters for these notes sooner or later! . . . **Shep Tyree** (now know as "Ty") reported in via a note from **Alan Katzenstein**. Ty retired from the College of William and Mary and has moved to his farm in Floyd, Va. He was elected as a delegate to the Virginia State Republican Convention and attended its meeting in Norfolk at the end of May. He wrote to Alan, "I had always thought that college kids were a little crazy (including you and me in 1938 to 1942). Now I realize that they are quite sane, almost sedate by comparison to convention delegates."

What with the aforementioned paucity of news, I'll lapse into a closing personal note. I was

elected to the National Board of Trustees of the United Israel Appeal which is the organization which raises funds from the American community for support of the state of Israel. Just one more item to compete with priority matters like our clients of **Ken Rosett/Associates** and playing golf. And the priority is not necessarily in that order!

If I have been successful in transferring any guilt at all to you, dear readers, sit down NOW and send me some class news.—**Ken Rosett**, Secretary, 191 Albermarle Rd., White Plains, NY 10605

43

You should see what **Jim Hoey** sent me this time. It's a features sections from the *Chippewa Herald Telegram*, Chippewa County, Wis. The major story in it is about **Frank Swenson** and his 6x13 ft. N-gauge model railroad. Frank, a radiation oncologist at Luther Hospital in Eau Claire, moved to his present home on Lake Wisconsin over six years ago. At that time, his hobby was radio-controlled model airplanes. But Wisconsin winters cut short his flying time, so he sold his planes and started building his model railroad. The article illustrations show Frank backed by walls of workshop tools and standing beside his miniature Chippewa Valley system. This is a small-scale civil engineering project, complete with hills, woods, streams, bridges, tunnels and many buildings. Frank is thinking about retiring from medical practice next year so he can devote full time to railroading.

Jim also reports that **Dick Fallows**, of Newton Highlands, Mass., plans to retire at the end of 1985 after 27 years with MITRE Corp. Dick has four daughters, including an Institute alumna ('74) and a member of the M.I.T. staff. He also has a grandson to help occupy his retirement years.

Art Angelos is still presiding over his high-tech company in Alexandria, Va. Golfomat is in the electronics manufacturing business, producing, among other things, an indoor golf simulator. Art has two boys, one girl, and 1+ grandchildren. . . . **John Hummer** (Course VI) is a recently-frocked lawyer now working as a patent attorney in Reston, Va. The welcome mat is out for crazy inventors and their weird brainchildren. . . . I'm sorry to report that **Clyde A. Booker, Jr.** (Course VI) died last April. He was employed as an advisory engineer with Westinghouse in Pittsburgh. There is no information about survivors.

Andy Plonsky has sent a thumbnail biography beginning with his employment in 1945 by the New Haven Railroad. Two years later he moved to Scranton, Pa., to establish a department of either engineering or agriculture (his handwriting is somewhat cryptic) at the University of Scranton. The story then jumps to 1970, when he started up a department of computer science at University of Scranton. He is presently teaching part-time in computer science. Andy lives in Scranton with wife Dorothy, enjoying the blessings of three sons and eight grandchildren. . . . The final item is from **George Potts**, a prominent feature of our 40th reunion. George says that keeping up with amateur radio, golf, photography, and sculpturing make the time fly. He is looking forward to the 45th. He also included a nice compliment for your secretary and the Class Notes. Thanks, George.

Have you written to your Secretary today?—**Bob Rorschach**, Secretary, 2544 S. Norfolk, Tulsa, OK 74114

44

Sadness tinges our report this month. **Carl "Lindy" Lindemann** passed away in June. He was an outstanding member of the class, not only for his career achievements, but also because he brought a great deal of joy to those whose lives he touched. Those of us who were with him at

Public Television

Fall Preview



Featured on PBS:

'The Last Place on Earth'

And
War
Mystery!
River Journeys
Nature
Wonderworks
Creation Of
The Universe
Great Performances
Treasure Houses
Of Britain
and more inside...

This special section
in the Leadership
Network* magazines
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*The magazines include:
Across the Board,
Commentary,
Columbia Journalism Review,
National Review,
The New York Review of Books,
The New Republic, and
Technology Review.

Mobil Masterpiece Theatre

Two Men, One Great Ambition

"The Last Place on Earth," a six-part drama based on the epic Scott-Amundsen race to the South Pole. Starts October 20 at 9 p.m. Eastern Time.*

*CHECK LOCAL LISTINGS

The day Robert Scott finally reached the South Pole, on January 17, 1912, was undoubtedly the worst of his horrendous 850-mile journey. For in that arctic vastness he found the tent left by his rival explorer, the Norwegian Roald Amundsen, whose team had beaten Scott by one month. **Mobil Masterpiece Theatre** opens its 15th season with "The Last Place on Earth," a six-part dramatization of the Scott-Amundsen race to the South Pole, which reveals a less flattering side of Scott that some historians have ignored.

"In England Scott is held up as a hero to school children," said director Ferdinand Fairfax in an interview about the series. "Scott was brave, full of reserve and aplomb, a perfect gent. He's the ideal English hero. He failed and then he died. Amundsen is held up as a cad, the man who survived by eating the dogs. People overlooked that Scott ate the horses."

Scott, played by Martin Shaw, is ill-prepared for his mission despite his familiarity with the realities of the region (he had a gold medal from the Royal Geo-

Martin Shaw
as Scott

Sverre Anker Ousdal
as Amundsen

Crystal Anniversary for Mobil Masterpiece Theatre

Fifteen years ago if you made a call on a Sunday night, you probably reached a friend willing to chat. Then, in January of 1971, the lines went cold; if you dared to dial, a voice would inform you that it was impossible to talk—at this very minute Churchill was waging the Battle of Blenheim, or Poldark was bedding Demelza, or Lillie Langtry was risking social ruin by pouring a drink down the back of Edward VII.

Mobil Masterpiece Theatre had arrived; the only voice you wanted to hear on

a Sunday night was Alistair Cooke's. And with this arrival, the miniseries was born.

"The First Churchills" (the first **Mobil Masterpiece Theatre** presentation) introduced the miniseries to American TV viewers, who over the next few years began to talk of the dashing Poldark or the homey Mrs. Bridges as though they were members of the family. Miss an episode, and you risked smiling blankly at the talk of next Saturday night's dinner party. (Over the years, **Mobil Masterpiece Theatre** has re-

ceived many Emmy awards. "Upstairs, Downstairs" alone received seven Emmys, and is the series most often associated with **Mobil Masterpiece Theatre**.)

It was not just that **Mobil Masterpiece Theatre** drew us so firmly into other people's lives; "Ma Perkins" had done that years ago. It was that **Mobil Masterpiece Theatre** did it so well, featuring brilliant performers like Alan Bates, Glenda Jackson, Derek Jacobi, Rosemary Harris, Anna Massey, Anthony Hopkins, and many more. (This season Max Von Sy-

dow in "The Last Place on Earth" and Diana Rigg in "Bleak House" are added to the list.)

Five years ago Mobil, which has been underwriter for **Masterpiece Theatre** since its inception, decided to provide similar backing for "Mystery!" and now when you call a friend on Thursday nights a voice explains that it is tied up helping Sherlock Holmes in his Baker Street digs, or lending a hand to those "Partners in Crime," Tommy and Tup-pence. Oh dear.

The Mobil Television Season on PBS 1985-86

Masterpieces

Masterpiece Theatre 9pm Sundays, Begins October 13

The Good Soldier The Last Place on Earth The Irish R.M. II
Lord Mountbatten: The Last Viceroy The Tale of Beatrix Potter
Bleak House The Jewel in the Crown By the Sword Divided I

MYSTERIES!

Mystery! 9pm Thursdays, Begins October 24

Death of an Expert Witness Agatha Christie's Miss Marple
The Adventures of Sherlock Holmes II Charters & Caldicott
Partners in Crime I & II My Cousin Rachel Praying Mantis
Agatha Christie Mysteries

& Specials

Pride of Place: Building the American Dream The Compleat
Gilbert & Sullivan The TV Businessman The Living Planet
King Lear

from Mobil®

MOBIL
MASTERPIECE
THEATRE

15TH
ANNIVERSARY
SEASON 1985-6

Chermayeff & Geismar Associates

CONTINUOUS SUPPORT
OF PUBLIC TELEVISION
MADE POSSIBLE BY A GRANT FROM **Mobil**®

Mobil Masterpiece Theatre

graphical Society for an earlier expedition to the Antarctic). He decides to use mechanical sleds, and we watch as the treads break down and sink through the ice; in addition to sled dogs, he uses ponies to carry equipment, but then has to cart their food along (unlike the dogs, the horses don't eat blubber); he brings skis for his men, but they end up abandoning them because they don't know how to use them.

Scott does little else to inspire the crew's confidence. One of his men, lying in bed with a bandage over his eyes, growls, "Ten years ago, when I was 20, I drove a team of dogs across Siberia 2,000 miles. I learned the narrowness of the line man walks between farce and tragedy. Tell him [Scott] that a man who sits in his tent in the Antarctic and whines about the weather is unfit to lead." The cold, however, seems to dampen everyone's spirits, and Amundsen, played by Sverre Anker Ousdal, is shown arousing hostilities in his men as well. (Max Von Sydow plays Amundsen's mentor, Fridtjof Nansen.)

Scott's wife, Kathleen, an independent woman who pursued her own interests as an accomplished sculptor, is played by Susan Wooldridge (Daphne Manners in "The Jewel and the Crown," which will be rerun later this season). Kathleen is the dominant force in the marriage, pushing Scott to pursue his explorations. When he becomes discouraged with all the arrangements for the expedition, she snaps, "It's not detail. It's destiny!"

The expanse of ice and snow that contributed to the film's stark beauty led to special problems. "The snow had to be unbroken. There couldn't be a lot of footprints at the South Pole, so whenever we shot the expedition coming toward us, we had to loop way back so that they could come forward over fresh snow," said Fairfax. He also came to appreciate the problems Scott and Amundsen had with crews and cold weather. The film crew spent eight weeks in Canada's Frobisher Bay and two in Greenland, where temperatures ranged from minus 20 to minus 59. "People always say when you get into those temperatures, it's the machinery that lets you down. It isn't. It's the people. People get slow and grouchy about things."

Some English viewers inevitably were unhappy with Fairfax's portrayal of Scott and his wife. (Imagine Neil Armstrong climbing out of Apollo 11 and stumbling over a Russian guidebook, and you'll be better able to understand British resentment toward Amundsen.) But, said Fairfax, "It seemed legitimate to look at who this man really was. . . . Every word that we could base on what someone wrote or said, we did. Those interested in

maintaining the Scott myth didn't like this at all."

The undisputed facts are the bleak outcome of the return trip. On February 17 one of Scott's men fell descending the Beardmore glacier and died soon after. Blizzards slowed the rest of the party and food began to run out. On March 17 another of the men walked out alone into the blizzard to die. The three survivors covered ten more miles and then another blizzard sealed them into their tent, where, out of food and only 11 miles from fresh supplies, they died.

On March 29, Scott wrote a final entry in his diary: "Every day we have been ready to start for our depot 11 miles away, but outside the door of the tent it remains a scene of whirling drift. . . . We shall stick it out to the end, but we are getting weaker, of course, and the end cannot be far. It seems a pity but I do not think I can write anymore."

When Amundsen returned to England, he met with a reception as icy as the land he'd just left. On **Mobil Masterpiece Theatre's** 15th season, in a film that is beautifully photographed and impressively acted, he is finally given credit for being the first man to reach "The Last Place on Earth."

Presented by WGBH.

Funded by Mobil Corporation.

Diana Rigg in "Bleak House"



Bleak House

"Bleak House," an eight-part drama of the Dickens classic. Begins December 1 at 9 p.m.*

*check local listings

The scourge of lawyers and legalese is nothing new, as this masterful adaptation of Dickens's novel Bleak House shows. The case of Jarndyce v. Jarndyce—about the complicated execution of a will—goes on and on, drawing more and more people in its wake. Characters with mysterious pasts and names like Mrs. Pardiggle, Prince Turveydrop, and Guppy keep popping up as this Victorian world sinks into decay.

The story should have particular appeal to the American audience, knee-deep as the country is in lawyers. Dickens uses the law case to show how society has got itself by the tail, chasing about in circles instead of moving forward. One of the unwilling participants explains: "The lawyers have twisted it into such a state of bedevilment that the original merits of the case have long disappeared from the face of the earth." Diana Rigg stars as the restless Lady Dedlock, whose "weariness of soul lies before her, as it lies behind," and Denholm Elliot is The Guardian. Lawyers, laymen et al. are urged to watch.

A commentary by Gwynne Dyer...

The Eight Episodes

WAR



"WAR: A Commentary by Gwynne Dyer,"
an eight-part series beginning October 1 at 9 p.m.*
*check local listings

War, the horrible but inevitable response to conflict, has been with us at least since civilization. It once affected mainly soldiers and leaders, but in the last two centuries has escalated to alarming proportions. This sobering eight-part series, "War: A Commentary by Gwynne Dyer," chronicles the last 200 years of man's fight against man.

The programs were shot on location in ten countries, including the U.S. and USSR, and we see the armed forces of six nations. Dyer interviews a range of people knowledgeable about warfare—historians, philosophers, prominent generals, young recruits. In the second episode, for example, a group of young men arrives at Parris Island, and they're turned into "highly motivated truly dedicated rompin' stompin' bloodthirsty kill-crazy United States Marine Corps recruits, SIR!" The poor young men, heads like billiard balls, eyes terrified, struggle to become soldiers as their socks droop, their rifles get dirty, as they dangle from ropes, scramble up nets, or set up tents ("You only did one thing wrong—it's inside out").

"I guess you could say in a way I brainwash 'em a little bit," one drill instructor admits. "You couldn't survive in a combat situation with the morals you have in everyday life," says another. "If you get paid to look down your sights and pull a trigger and kill a man, that's what you do."

"The secret of basic training," said Dyer later during a discussion about the

program, "is that it's not really about teaching people at all; it's about changing people to do things they wouldn't ordinarily do. The recruit is stripped of all evidence of his civilian identity—his hair, his clothes, everything that makes him an individual."

If the common soldier is merely following orders, then is war the fault of the officer—the one who, according to writer Paul Fussell, knows precisely "how much of his soldiers he can use up and get the job done"? No, explained Dyer; by agreeing to become soldiers, all of them agree to die when asked to—by whomever makes the ultimate decision to fight.

"Here you have a bunch of people who you pay and train to kill foreigners. Put that way, it doesn't sound like the kind of profession you'd like your child to go into."

"But the thing that gives it some dignity is that they also have to be willing to be killed. In the end, I think the problem is the sovereign state. How do you get to the point where you can surrender some of your sovereignty? After the First World War, we had scared ourselves so badly we formed the League of Nations and that didn't work too well. Then after the Second World War, the governments got together in the United Nations. The writing's on the wall. It says, 'March barefoot to Mongolia.' It's a hard task but it's pretty clear it's the direction we have to go in."

What Dyer does, and does well, is show how good and intelligent people of

1 Episode one: "The Road to Total War." Dyer shows how modern nationalism and modern technology have joined to change war from battles between small groups of professional soldiers to the destruction of millions. With paintings, photographs, and film, this episode documents the terrible excitement of war—and the terrible consequence.

2 Episode two: "Anybody's Son Will Do." Dyer visits Parris Island and follows a band of green recruits as they are turned into professional soldiers in this sometimes moving, often wry segment.

3 Episode three: "The Profession of Arms." Here we see the remarkable similarity in military jobs all over the world. The military officers of various countries may have more in common with each other than with their own countrymen. In one of many interviews, General Ben-Chanan of the Israeli Defense Forces speaks candidly of a truth all officers learn: you can do everything right and still get it wrong—lose the battle and your men.

4 Episode four: "The Deadly Game of Nations." Dyer looks at why governments—and the people they represent—feel the need to keep armies and fight wars. Israel, with its struggle to hold its own among the Arab nations of the Middle East, is the focus.

5 Episode five: "Keeping the Old Game Alive." Dyer documents NATO's conventional war games, held every autumn in central Europe as the combined forces of 15 member countries conduct an elaborate dress rehearsal for World War III.

6 Episode six: "Notes on Nuclear War." Dyer follows the development of the arms race, from Hiroshima to the Cuban missile crisis to the current nuclear stalemate.

7 Episode seven: "Goodbye War." From the League of Nations to the United Nations, Dyer talks about why efforts to achieve a worldwide peace have failed.

8 Episode eight: "The Knife Edge of Deterrence." This final segment was not part of the original series; it was produced by station KCTS in Seattle, and hosted by Edwin Newman. It presents alternative viewpoints, focusing on deterrence, from Truman's post-WW II administration to Reagan's "Star Wars" plan.

Mobil
Masterpiece
Theatre
presents:

The Last Place on Earth



Scott and Amundsen
both wanted to be first
to the Pole.
One of them won.
The other became a hero.

Starring Sverre Anker Ousdal,
Martin Shaw, Max Von Sydow,
Susan Wooldridge

A six-part series begins Sunday
October 20 at 9PM on PBS

Check local listings

Host: Alistair Cooke

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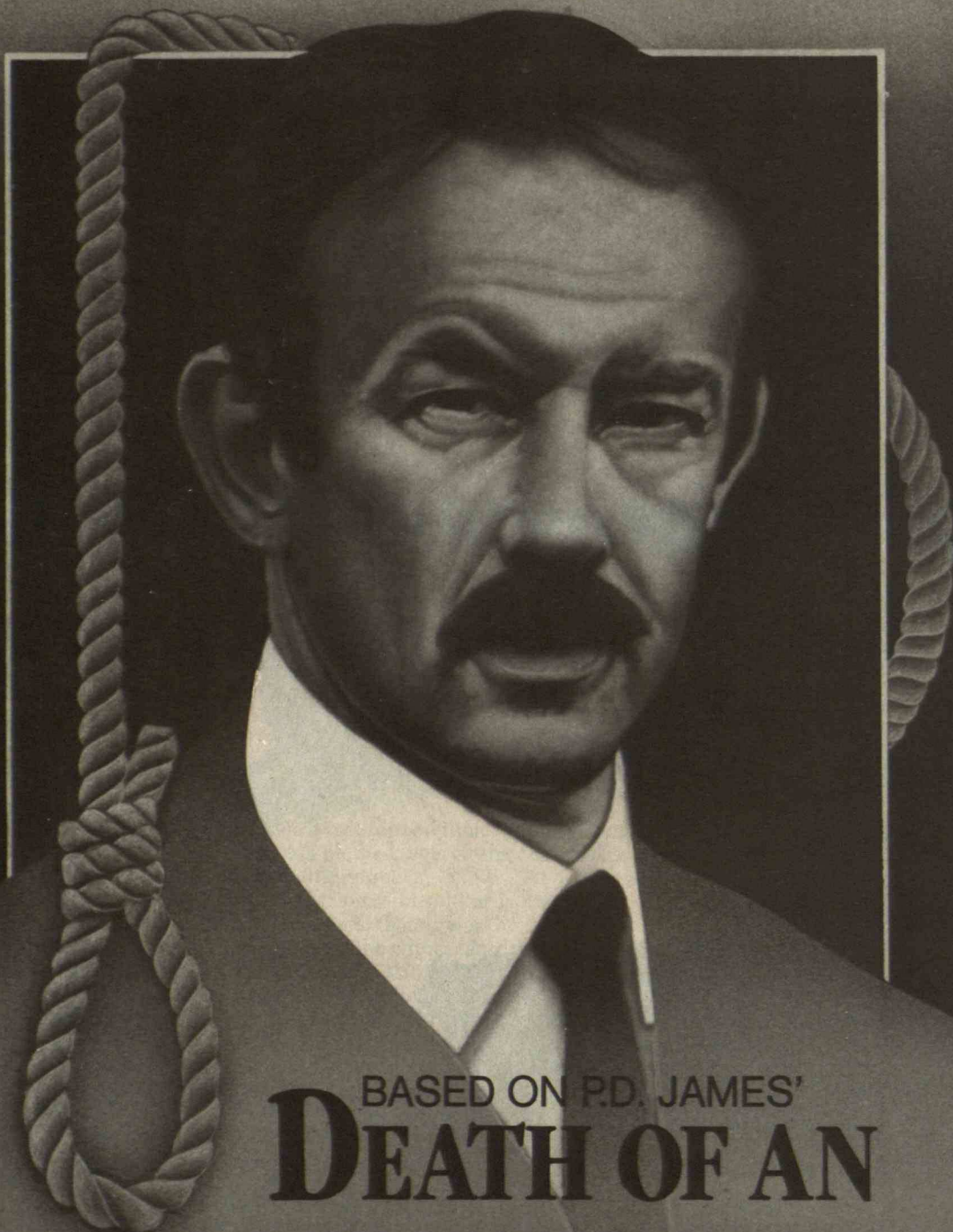
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SEASON 1985

Based on *The Last Place on Earth* by Roland Huntford, published by Atheneum and
available in bookstores.  Closed captioned for hearing impaired viewers

Cherrywell & Gensler Associates

MYSTERY!

PRESENTS



BASED ON P.D. JAMES'
**DEATH OF AN
EXPERT WITNESS**

EACH SUSPECT WAS A MASTER AT FINDING CLUES — AND HIDING THEM

Starring: Roy Marsden

A 6-part series begins Thurs. Oct. 24, 9PM on PBS Check local listings

Host: Vincent Price

☐ Closed-captioned for hearing impaired viewers

Death Of An Expert Witness, published by Warner Books, available in local bookstores.

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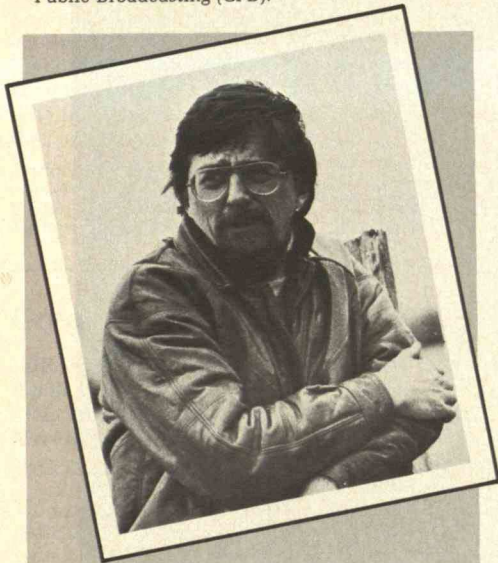
varying professions and responsibilities slip step-by-step into the throes of war. He lets the interviewees speak without setting them up to prove his point. His warriors are not evil; they are men doing the job they've been asked to do.

"It's a complicated and slippery business which can't be blamed on arms merchants or ideologues. If I got it right, the series ought to be an analysis rather than a polemic."

"We've gone on fighting wars all through our history because we've been willing to pay the price," said Dyer. "Now the price is too high."

Not everyone agrees on the price, and there will always be differences when determining what's worth fighting for. Dyer's enlightening commentary, however, graphically demonstrates how terribly costly anything worth fighting for is.

Produced by the National Film Board of Canada and KCTS. Funded by Public Television Stations (PTV Stations) and the Corporation for Public Broadcasting (CPB).



Gwynne Dyer, who writes an international affairs column that appears in 200 newspapers in 50 countries, is well qualified to talk of war. His military experience includes service as a reserve officer in three navies (Canadian, American, British), two years of teaching military affairs at the Canadian Forces College, Toronto, and four years as a senior lecturer in war studies at Britain's Royal Military Academy, Sandhurst. "War: A Commentary by Gwynne Dyer" grew out of a radio program called "Goodbye War," which aired in Canada in 1979 and has since been broadcast in seven countries, including the United States.

Dyer, who lives in London with his wife and two teenage sons, concludes that we can no longer afford a tit-for-tat world. "Truth is," says Dyer, "we love our countries too much for their own good. And for ours."

Who watches what...

Irving Kristol, editor of *The Public Interest*, likes the British imports best—"Brideshead Revisited" and **Mobil Masterpiece Theatre's** "The Jewel in the Crown." He also watches **The MacNeil/Lehrer Newshour**.

William F. Buckley, editor of *National Review* and host of PBS's **Firing Line**, doesn't have much time for television, but enjoyed "Upstairs, Downstairs," which was presented on **Mobil Masterpiece Theatre**.

Mayor Ed Koch likes to relax in his library and watch **Mobil Masterpiece Theatre**.

Senator Daniel Patrick Moynihan tunes in regularly to **The MacNeil/Lehrer Newshour**.

Senator Jay Rockefeller, whose wife, Sharon, is on the board of the Corporation for Public Broadcasting, obviously watches a lot of public TV. His favorite: **Washington Week in Review**.

Secretary of Transportation **Elizabeth Dole** likes to settle down with **The MacNeil/Lehrer Newshour**.

John Updike says, "My wife and I have both been very attentive to the program on China and we're addicted to **Mystery!** Some years ago I liked Kenneth Clark's 'Civilisation' and 'The Shock of the New,' and there's one about nature—David Attenborough's 'The Living Planet'—which I enjoy. There are times when you can see one too many praying mantises, but by and large I like watching it."

Judy Woodruff, of **The MacNeil/Lehrer Newshour**, says, "I watch **Frontline** and **MacNeil/Lehrer**, but not necessarily in that order. And also **Masterpiece Theatre**." But the television in the house she shares with husband Al Hunt of *The Wall Street Journal* is usually tuned to **Mister Rogers' Neighborhood** or **Sesame Street**. Those are the programs her three-year-old son likes to watch.



Irving Kristol



William F. Buckley



Mayor Ed Koch



Senator Daniel Patrick Moynihan



Senator Jay Rockefeller



Secretary Elizabeth Dole



John Updike



Judy Woodruff

Mobil Masterpiece Theatre presents
Charles Dickens'

BLEAK HOUSE

Starring Diana Rigg & Denholm Elliot

An eight-part series begins


Sunday, December 1 at 9 PM on PBS

Check local listings

Host: Alistair Cooke

Jarndyce vs. Jarndyce:

No man alive could understand it—
or settle it.

 closed captioned for hearing impaired viewers
Bleak House is available in paperback from Bantam Books.

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Briefings..

Wonderworks

"KONRAD," a two-part program, October 7 and 14, 8 p.m.*

*CHECK LOCAL LISTINGS

This year **Wonderworks** has a 25-week season that includes stars such as Loretta Swit, David Birney, Carol Burnett, and Carrie Fisher.

Many a parent has wished he or she could put that boisterous little boy in a box, but Konrad starts out there, a factory-made child delivered to the wrong address. The eccentric Mrs. Bartolotti, stunned by the arrival of the crated Konrad, soon settles into motherhood. Ah, but the factory wants him back and thus begins a hilarious campaign, waged by Ned Beatty and Polly Holliday (the smart-talking Southerner Flo from "Alice"), to keep Konrad (played by Huckleberry Fox, the younger son from *Terms of Endearment*). The programs presented on **Wonderworks** have been chosen with children particularly in mind, and are done with such skill that parents will want to watch as well.

Produced by the Children's and Family Consortium (WQED, KCET, KPCA, South Carolina ETV, WETA). Funded by CPB, PTV Stations, and the National Endowment for the Arts.

Great Performances

"DR. FISCHER OF GENEVA," October 11, 9 p.m.*

"OLIVIER: A LIFE," October 25 and November 1, 9 p.m.*

*CHECK LOCAL LISTINGS

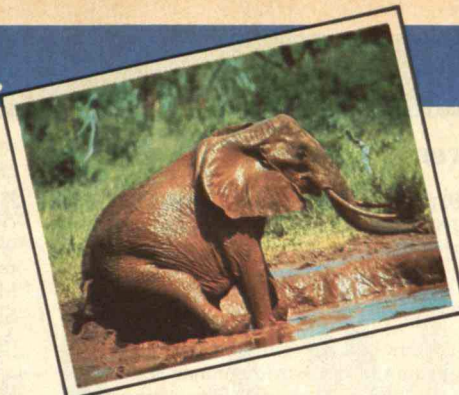
TV's longest-running performance series launches its 13th season this fall with a wonderful lineup.

Last year Alan Bates was "An Englishman Abroad"; this year he's abroad again as "Dr. Fischer of Geneva," a wealthy eccentric who takes pleasure in finding out exactly how greedy the rich can be. Based on the Graham Greene story, the show features the late James Mason in one of his final roles.

Also on **Great Performances** this season is "Olivier: A Life," a biography of the great actor.

"I am now in my anecdoteage," said Laurence Olivier upon being asked what he planned to do with the rest of his life, and indeed he is in this two-part program of the man critic Kenneth Tynan called "the greatest actor alive." More familiar as the darkly romantic Heathcliff or the classic Henry V, the real-life actor is as fascinating as the characters he has played. Olivier, whose marriage to Vivien Leigh collapsed under her legendary alcoholism and infidelities, once said, "I sometimes have thought that my life was as cursed as some of the characters I played, for after every success I've had, something has come along to muck things up."

Produced by The Great Performances Alliance: WNET, KERA, KQED, South Carolina ETV, and WTTW. Funded by The Exxon Corporation, the National Endowment for the Arts (NEA), CPB, and PTV Stations.



Nature

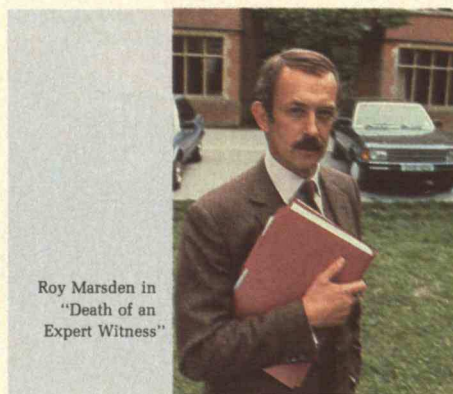
"AND THEN THE RAINS CAME," October 20, 8 p.m.*

*CHECK LOCAL LISTINGS

The critically acclaimed **Nature** series is back this fall for its fourth season. With stunning wildlife photography and informative narration, the natural world is explored in what has become the most watched regular series on public television. This season **Nature** presents 20 new one-hour programs as well as encore presentations from popular shows of past seasons. The series is hosted and narrated by George Page, who is also in charge of production for WNET.

The season's premiere, "And Then the Rains Came," takes a look at how the animals of Kenya's Tsavo plain survive nature's roller coaster of floods and droughts. The show begins with shots of plains barren from drought; then the rains come and thousands of creatures emerge from underground. But the cycle keeps repeating itself, and the earth returns to its dry and barren state.

Presented by WNET. Funded by PTV Stations and the American Gas Association.



Roy Marsden in
"Death of an
Expert Witness"

PENN & TELLER GO PUBLIC, a half-hour special, October 23, 9 p.m.*

*CHECK LOCAL LISTINGS

A magic show for people who hate magic shows. That's one way to describe this zany new addition to the PBS fall lineup. The "Penn & Teller" show is currently playing to sell-out crowds on off-Broadway. And for a good reason: their magic tricks are not of the usual variety. During the half-hour shows—in front a live audience—you'll see card tricks that are explained, an escape from a straitjacket, and fire-eating, all accompanied by a running commentary from the "bad boys of magic."

Produced by KCET. Funded by PTV Stations.

Mystery!

"DEATH OF AN EXPERT WITNESS," a six-part adaptation of the P. D. James mystery, begins October 24 at 9 p.m.*

*CHECK LOCAL LISTINGS

With shrieks, shadows, shots in the dark, "Death of an Expert Witness" opens the new season of **Mystery!** with a start. Hoggatt's is the setting, a forensic science laboratory in England's flat and misty Fen country, where crimes have a way of being committed as well being solved. One body, then two, then three are offered up. The laboratory's scientists can construct a killer from a single strand of hair, but what can they do when there, crumpled up in a corner of the room, is the body of the expert witness?

James's gentlemanly detective, Adam Dalgliesh (played by Roy Marsden), is what the British press call "a thinking man's copper"—an urbane fellow from Scotland Yard who does his sleuthing in a very civilized manner. He puts things right, of course, but not before poking his way through a pack of suspects and discovering an equal number of guilty secrets involving jealousy, desperation, revenge, blackmail, and secretive love.

Filmed entirely on location in Norfolk and the remote East Anglian fens, "Death of an Expert Witness" is the first P. D. James thriller adapted for television.

And also coming up on **Mystery!**

—"My Cousin Rachel," a remake of the classic Du Maurier tale about a young widow suspected of murdering her husband. Geraldine Chaplin stars as the cursed countess in this four-part presentation beginning December 5.* The cast includes Christopher Guard as Philip, Charles Kay (from "The Woman in White") as Ramaldi, and John Shrapnel as Ambrose Ashley.

—From the harsh beauty of Cornwall, it's back to London and Baker Street for six more episodes of the "Adventures of Sherlock Holmes." Jeremy Brett returns as Holmes and David Burke as Watson in the latest dramatization of Arthur Conan Doyle's puzzlers. Fans can look forward to "The Copper Beeches," "The Greek Interpreter," "The Norwood Builder," "The Resident Patient," "The Red-Headed League," and "The Final Problem," beginning January 2.*

Agatha Christie's Miss Marple toddles into view February 13* with the three-part "The Body in the Library," followed by "The Moving Finger" in two episodes, beginning on March 6*.

On March 20 in "Charters and Caldicott," comfortable old Caldicott—taken up with Club, colonies, and cricket—finds the body of a young woman in his apartment. The two eccentric Englishmen (first seen in Alfred Hitchcock's "The Lady Vanishes") spend the next three episodes finding out who done it.

Mystery! ends its season with five new stories in "Agatha Christie's Partners in Crime," starting May 1.* Set in the Jazz Age of the twenties, the series brings back Francesca Annis and James Warwick as amateur detectives Tuppence and Tommy Beresford.

Presented by WGBH. Funded by Mobil Corp

Briefings...

River Journeys

"A RIVER JOURNEY BY CHRISTINA DODWELL," November 6, 8 p.m.*
"THE MEKONG WITH WILLIAM SHAWCROSS," November 13, 8 p.m.*

*CHECK LOCAL LISTINGS

Six writers take six different journeys along some of the world's major waterways in "River Journeys." The program won the British Academy of Film and Television Arts Award for best factual series of 1984.

"A River Journey by Christina Dodwell" starts off the series. Dodwell has spent the last ten years exploring the world on horseback and in dugout canoe. She knew about the Waghi River (called the Eater of Men in New Guinea) from an earlier trip and she chose it for her river journey, in company with a team of white-water rafters.

The banks of the river harbor an exotic world where young boys entering manhood have their skin scored to resemble the scales of a crocodile and where the shriveled bodies of ancestors, smoked over a wood fire until they are as brown and leathery as a tobacco leaf, are hoisted up into baskets to guard the villagers. The native river people are fascinated as they watch the crew pump up the rubber rafts and set off down the deadly river. There are waves that are 20 feet high and black holes where man and raft disappear in a vortex of water. In the end, the river wins. Dodwell, who had never done white-water rafting before, admits to being frightened at first: "Fear can give you a tremendous boost, a surge of adrenalin, but in general it doesn't help at all."

"River Journeys" will air "The Mekong with William Shawcross" as the season's

second program. Journalist William Shawcross's journey up the Mekong River, which runs from Tibet through southeast Asia, is as much history lesson as travelogue. The communist officials who arrange his trip announce lyrically that the Mekong is a "river of solidarity." But, says Shawcross, author of *Sideshow* (about American involvement in Cambodia), "The Mekong divides rather than unites the region." Like a pebble skipped across the water, he must hop his way upstream, frequently forced by warring governments to abandon the river and fly on to his next stop. The lives of a peasant people drying rice by the roadside or tethering their goats to the roof of a boat to ferry them to market are viewed against the scenes of recent war—the hulk of a bombed patrol boat juts from the river and Shawcross meets the man who planted the explosive. There is a crippled baby brought out for the cameras, its deformed foot, the communist officials say, the result of defoliants used by the American forces. When Shawcross learns the little boy, who is crying and begging to go home, has been produced seven times for seven film crews, he becomes so upset that he apologizes over and over and finally shouts at the father to take the baby home and keep him there.

Shawcross says that, at first, "traveling in a cocoon of officialdom, I felt as isolated from the Vietnamese as the Americans must have felt—and the French before them." Shawcross, however, is a hard man to isolate. He breaks out time and again to interview the ordinary people of southeast Asia whose lives have so often been disrupted by war.

Presented by WETA. Funded by PTV Stations.

THE STATUE OF LIBERTY, a one-hour special, October 28, 9 p.m.*

*CHECK LOCAL LISTINGS

America's most famous lady reaches her 100th birthday next year, and to celebrate, a one-hour documentary, "The Statue of Liberty," will air on public television. Produced and directed by Ken Burns, whose film on the Brooklyn Bridge was nominated for an Academy Award, it traces the history of the statue and includes interviews with Mario Cuomo, James Baldwin, Ray Charles, Jerzy Kosinski, and poet Caroline Forshe.

Owl/TV

A weekly series of ten half-hour programs, beginning November 3, 5 p.m.*

*CHECK LOCAL LISTINGS

OWL/TV joins *Sesame Street*, *Mister Rogers' Neighborhood*, and *3-2-1 Contact* as part of PBS's programs for kids this fall. In this new series, children learn that the environment is more than bees, birds, and butterflies. "It might be the bedroom—making costumes out of junk. We need to broaden the word environment," says coproducer Annabel Slight. "In OWL, we have kids making pizza, building a fort. Kids think of their room, their city block as their environment."

But OWL/TV doesn't confine itself to the backyard. Most appropriately, they visit the owl lady, a charming champion of screech owls, burrowing owls, great horned owls and, indeed, any owl which has fallen on hard times. As the rescued birds munch their mice, the owl lady pops three abandoned baby owls into a strange nest: "Thank goodness owls can't count. She doesn't know that only three are hers. She thinks all six are."

An imaginative approach to the world around us, OWL/TV is being coproduced by Canada's Young Naturalist Foundation and the National Audubon Society, which plans to form Audubon Youth Clubs across the country to give young viewers a chance to become actively involved in nature and science projects. At the same time, the Young Naturalist Foundation will begin publishing its children's magazine, OWL, in the United States. "The magazine, while not duplicating the TV show, will tie in with it," says Annabel Slight, founding editor of the magazine and coproducer of the show.

Produced by The National Audubon Society and the Young Naturalists Foundation. Presented by WNET.




Christina Dodwell stars in "A River Journey..."


MYSTERY! presents Daphne du Maurier's

My Cousin Rachel

DESIGN/ILLUSTRATION: PAUL DAVIS STUDIO © 1985 MOBIL CORPORATION



Starring Geraldine Chaplin
To most men she was an angel—of death
A four-part series begins
Thursday, December 5 at 9 PM on PBS
Check local listings
Host: Vincent Price

 closed captioned for hearing impaired viewers

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MYSTERY! PRESENTS

THE ADVENTURES OF


SHERLOCK HOLMES

SERIES II

So clever they're elementary
Jeremy Brett as Sherlock
David Burke as Watson

A six-part series begins
Thursday, January 2 at 9 PM on PBS
Check local listings
Host: Vincent Price

Mobil®

 Closed captioned for hearing impaired viewers.
The Adventures of Sherlock Holmes, published
by Dell books, available in local bookstores.

Briefings...

NOVA "TORNADO!" November 19, 8 p.m.* *CHECK LOCAL LISTINGS

Nova, the award-winning weekly science documentary, will air new programs about video special effects, gene therapy, and technology in the workplace.

"Tornado!" is also one of the new shows. Most of what people know about tornadoes comes from watching Dorothy and Toto being whirled out of Kansas and into Oz, but now Nova looks at the real thing. These funnel-like storms occur in the U.S. at the alarming rate of over 1,000 a year. They hit every state and reach peak speeds of 70 miles per hour with interior winds of up to 300 miles per hour. The base of operations for scientists studying these storms is the National Severe Storms Laboratory in Norman, Oklahoma—the heart of "Tornado Alley"—where more tornadoes occur annually than anywhere else on earth.

Produced by WGBH. Funded by PTV Stations, Allied Corporation, and Johnson & Johnson.

CREATION OF THE UNIVERSE, a special 90-minute program, November 20, 9 p.m.* *CHECK LOCAL LISTINGS

"Every single atom in your body was once within a star"—host Timothy Ferris quotes an astronomer in "The Creation of the Universe," a program that can put a bad day at the office in perspective, reaching back, as it does, 15 billion years to the Big Bang. With five Nobel Laureates on its advisory panel and only one mathematical formula in 90 minutes, "Creation" not only makes quarks, neutrons, and protons as familiar as E.T., but also follows physicists in their search for a Unified Field Theory. This universal formula would account, says Ferris, "for every fundamental process in nature, from the jostling of atoms to the wheeling of the galaxy." Brian Eno wrote the music that accompanies Ferris as he makes his way back through time searching for the secret of the universe.

Produced by Northstar Associates. Funded by Texas Instruments.

COMET HALLEY, a one-hour special, November 26, 9 p.m.* *CHECK LOCAL LISTINGS

In 1705 Edmond Halley predicted that the comet later named for him would reappear in 1758. By calculating the orbit of the comet, he moved those bright and mysterious balls from the area of folklore into science. "Comet Halley" will reappear in 1986 and is the subject of a one-hour documentary. The executive producer, John Wilhelm, is a former science correspondent for Time and a former senior editor of Science 80.

Produced by John L. Wilhelm, WETA, and Japan's Asahi Broadcasting Corp. Funded by M&M/Mars Inc., the CPB, Asahi Broadcasting Corp., and the Planetary Society.

TREASURE HOUSES OF BRITAIN, three one-hour programs, December 16, 9 p.m.*; December 23, 10 p.m.*; December 30, 9 p.m.* *CHECK LOCAL LISTINGS

When you look out on your lawn and sigh at the sight of all those leaves waiting to be raked, think of the poor Duke of Buccleuch with three houses and 300,000 acres, all in need of tending. There are, of course, compensations to being the master of Drumlanrig Castle and Bowhill in Scotland and Boughton House in England: the only privately owned Leonardo da Vinci dwells there, for instance, and 45 Van Dyke miniature portraits hang in a single room. The fine art and fine furniture is so impressive that, according to Nancy Mitford, the curator of the Louvre once apologized to the late Duke that the Louvre's

One of the treasure houses of Britain



SMART TALK ON PBS

And for those caught up with the talk-show biz, there are the following:

The MacNeil/Lehrer Newshour, airing weekdays, is now in its third season covering major news stories with a blend of interviews and discussions, documentary reports and special features.

Washington Week in Review wraps it all up at the end of the week, Fridays at 8 p.m.* Paul Duke and a panel of journalists discuss the issues that dominate the front pages.

In **Wall Street Week** Louis Rukeyser, the only man on TV with his own elves, takes stock of the stocks after taking stock of the news. On Fridays, 8:30 p.m.*

Each week on **Firing Line** that inimitable conservative William Buckley puts a guest to a battle over current events.

*CHECK LOCAL LISTINGS

French furniture was not as good as the Buccleuchs'. With the National Gallery of Art opening "The Treasure Houses of Britain: Five Hundred Years of Private Patronage and Art Collecting" on November 3, and Prince Charles and Princess Diana arriving on November 8, PBS checks in with "Treasure Houses of Britain," three one-hour programs strolling through the stately homes from Tudor times to the Victorian era, when newly rich industrialists settled themselves into ersatz castles. The beautiful objects are coupled with good gossip, as when the program explores the caves at West Wycombe where Sir Francis Dashwood and his fellow members of The Hell Fire Club got up to some very naughty things' indeed.

Presented by WETA. Funded in part by the Ford Motor Company.

Mobil Masterpiece Theatre presents

LORD MOUNTBATTEN THE LAST VICEROY

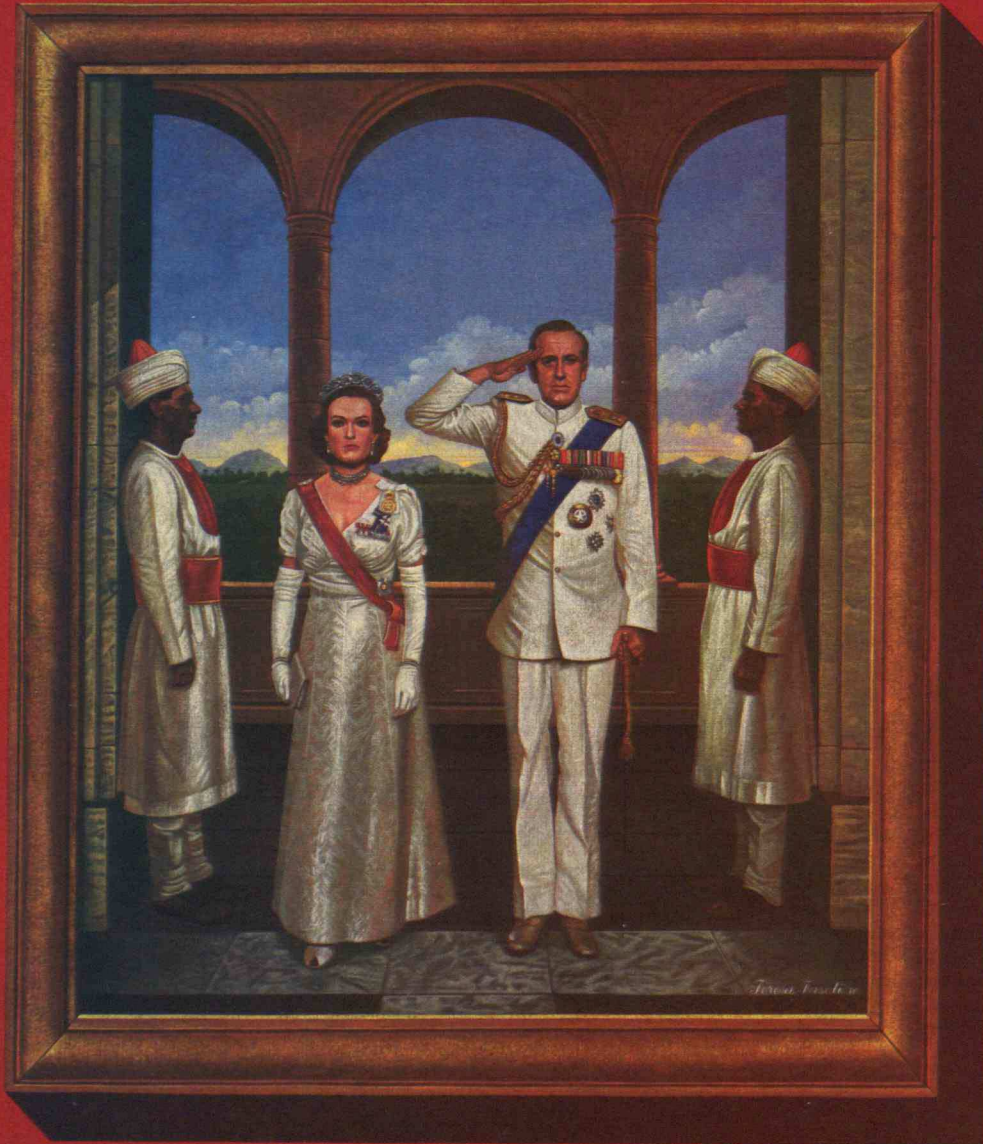



Illustration: Teresa Fasolino Design: Chermayeff & Geismar Associates

Some called
it betrayal—
Others, his
finest hour

A six-part series
starring
Nicol Williamson
Janet Suzman

Begins Sunday 9PM
January 26 on PBS
Check local listings
Host: Alistair Cooke

 Closed captioned for
hearing impaired viewers

Lord Mountbatten: The Last Viceroy, published by
Pocket Books, is available in local bookstores

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SEASON 1984

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Officer Candidate School at Fort Monmouth, N.J., cherish the many light-hearted moments he gave us in the sometimes grim pursuit of the gold bars of a second lieutenant. "Lindy" who retired last year as vice-president of and assistant to the president of CBS Sports, died at his home in South Freeport, Maine.

After serving in World War II, he joined NBC as a studio and field cameraman for "The Kate Smith Show," ultimately becoming associate producer of the show. In 1954, he transferred to the NBC television network, programming department, and in 1959 was named vice-president of daytime programs.

As vice-president of special projects for NBC News, he supervised production of the "Today" show as well as the network's coverage of space launches.

He was named vice-president of NBC Sports in 1963. After acquiring the broadcast rights for the 1980 Summer Olympics, Lindy left the network, becoming co-owner and executive producer of the National Hockey League Network.

In June 1978, he joined CBS Sports as vice-president of programs, responsible for major league baseball, the Rose Bowl, the Orange Bowl, the Wimbledon tennis championships, and NCAA basketball.

Our sympathy goes to his family—he will be missed by all of us.

In other news, Anita and Les Brindis, Jane and Louis Demarkles and Andy Corry, met at the home of Ruth and Norm Sebell on June 12, to continue to develop plans for the mini-reunion in Williamsburg on November 1, 2 and 3, 1985.

We've had expressions of interest from about 120 classmates and by the time you read these notes, Bud West should have the program pretty well in hand. Tentative plans are for dinner on Friday evening; dinner, entertainment and dancing on Saturday evening; and a farewell dinner on Sunday, with the remaining time left for individual activities. While the deadline for reservations guaranteed by the class has passed, there still may be space available if you contact Williamsburg promptly. We hope to see you there.

The American Association for the Advancement of Science (AAAS) announced that Peter Elias, Edwin S. Webster Professor in the department of electrical engineering and computer science was elected chairperson-elect of the engineering section. . . . William H. Tucker sends word of his retirement from chairman of chemical engineering, Tri-State University, Angola, Ind., and as director of TSU Energy Analysis and Diagnostic Center. After remarriage in March, he will live in Riverside, Calif. . . . Bruce P. Bogert, retired after 33 years at Bell Laboratories in New Jersey, is a candidate for election to the Planning Board in the Town of Rockport, Mass. He is particularly concerned about water conservation and the preservation of Rockport against overdevelopment.—Co-Secretaries: Andy Corry, Box 310, West Hyannisport, MA 02672; Lou Demarkles, 53 Maugus Hill Rd., Wellesley, MA 02181

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It's a mixed bag of news this month. The good news came from John Knause back in June in the form of a sympathetic, newsy letter. John has started his 23rd year as dean of the graduate school of Oceanography at the University of Rhode Island. He says he used to get out and study the Gulf Stream, but now it's mostly administration and a bit of teaching. John held the distinguished (volunteer) job of chairman of the President's National Advisory Committee on Oceans and Atmosphere. Turns out this was the "nothingsburger" job that Ann Burford turned down. Meanwhile John takes delight in sailing his Bettle Cat, a pre-plastic boat, out of Saundertown (R.I.) Yacht Club. The "old guard" still races those old Cats, although no one under 45 to skipper. Go for it, John!

Then there's Ernie Buckman, old swim team

stalwart, who spoke about "Property Management: An Emerging Science" at an M.I.T. Spring Lecture Series at the Center for Real Estate Development. Ernie's chairman of Oliver Realty, based in Pittsburgh; is on the board of directors of the Alumni Association; and is recipient of the Bronze Beaver Award, just to name a few of his notable achievements.

A news clip from the Draper Lab has a picture of Phil Bowditch cutting cake with a sword at a change-of-command ceremony as he transfers leadership of the Oceans and Scientific Systems Department. Phil, who joined the Lab 35 years ago, wants to devote more time to engineering. He still lives in Cohasset, Mass., in case you'd like to get in touch.

The sad news is the Howie Auerswald (whom we saw at the 35th) died suddenly and unexpectedly April 10. Howie, another swim teammate, had many accomplishments, both professional and civic. A Course I grad, he progressed into chemicals and formed his own companies manufacturing plastic squeeze tubes and the like. Living in Suffield, Conn., Howie served as a bank director in Easthampton; a member of the board of development for the Clarke School for the Deaf in Northampton; and member of the advisory council of Bay Path Junior College, to name but a few. He left wife, Joy, three sons, a daughter, a stepson, and four grandchildren. In 1965 he received a bronze medal from the Carnegie Hero Fund Commission after he had saved the life of a scuba diver and towed a second diver to safety while vacationing in Fort Lauderdale. He will be sorely missed. If you'd like to write to Joy, her address is 421 Remington, Suffield, CT 06078.

Another sad note coming through the grape vine tells of Russ Dickey's demise in early January out in West Covina, Calif. Russ, a Course VI'er out of Pawtucket, migrated to the West Coast in the early fifties and went to work for General Dynamics, Pomona. He had been ill for some time prior to his death. He is survived by his wife, Stella, and four sons. Again, if you'd care to write, Stella can be reached at 639 Prospero Dr., W. Covina, CA 91791.

Finally, a class member unknown to me, Jacob Ullmann died in New York on February 5. No obit available. . . . Keep the Faith!—Jim Ray, Secretary, 2520 S. Ivanhoe Pl., Denver, CO 80222

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The joint reunion of '47, '48 and '49 was held in Newport, R.I. in June. The formal dinner dance at Rosecliff Mansion was a gala event. The ballroom was spacious—with 65 couples seated for dinner and a seven-piece band, a large area was still available for dancing. John Kirkpatrick brought his trombone and joined the orchestra for several numbers. Many classmates took a tour through the mansion, while some had champagne on the patio overlooking the ocean. Pictures were taken of each couple standing on the heart-shaped staircase that leads to the upper floors.

Eleanor and Harold Ottobriani arranged the important details with the caterer, florist, band, and the result was, as Warren King wrote, "a tremendous success." Harold's daughter photographed everyone, and by the next day everyone had a print of their picture. Each dining table had a floral piece, so the ballroom was filled with colorful flowers. The weather cooperated, and guests walked outside in the gardens, around the fountains, and down to the wall overlooking the rocky shoreline. During the breaks between dancing, the more romantic couples strolled on the lawn near the fountain under a star-studded sky.

The next night we had an old fashioned New England clambake conducted by an experienced professional who has done clambakes for the America's Cup groups and many other members of Newport society. After a huge fire on the rocky shore to heat a mass of rocks, he placed clams, sausage, fish, and lobster among the seaweed

and covered the bake with wet tarpaulins while the food cooked slowly to a mouth-watering finish. The bake was served at tables in the Fort Adams Olympic Center, which earlier visitors to Newport may remember as the mule barn.

John and Gerry Kunstadter, both class of '49, attended and are a good example of why we had a joint reunion since they started with the 2-48 class. Gerry's maiden name was Sapolsky. Both of them are spending a large part of their time managing a charitable foundation that is active in several areas. One-half of the classmates attending the reunion were members of our class. Ken Brock wrote to congratulate the committee and voted for another event in five years.

George Clifford, class president, has appointed Bob Sandman chairman of our 40th reunion in 1988. Bob has been chairman of one or more events for previous reunions, and his experience as president and international secretary of the Electrical Apparatus Service Assn. will be an asset. Bob owns and operates Sandman Electric, a large New England electrical apparatus service company. . . . Lou Kreek has joined a small law firm with three partners, a dozen employees, and two offices. He will be in their Akron, Ohio office. The firm is well known for patent and copyright law. Lou has specialized in patent law for many years and was previously with ICI Americas. Lou and Gwen have purchased a new home in the Akron area. Good luck to both of you. . . . Len Stutman is a cardiologist at St. Vincent's in New York City. In addition, he has responsibilities at the Nyack Medical Center, about 40 miles from the city.

Dan Fink started his own firm in aerospace/defense/electronics in August 1982 after he retired from General Electric. His consulting business was keeping him near Washington so frequently that he and Tobey moved to Potomac, Md. in December 1984. He is often involved in corporate strategy issues. In addition, he is a director on the board of several companies. He chairs the advisory council of NASA, and the board on telecommunications and computer applications of the National Research Council. Dan has been able to make more time for golf recently. He and Tobey have had time to enjoy their first grandchild, and their second is on the way.

Sonny Monosson added a new newsletter in March to his previous two newsletters. All three are published by Monosson Technology Enterprises. Monosson's DEC-Market Weekly tracks news in the \$12 billion yearly market for Digital Equipment Corp. and DEC-compatible vendor's products. "Third-party vendors, large users, OEM's putting together new systems, and sales staffs who need to know about new add-ons and software are all people who need to keep track of what's going on," says Sonny. "They need to know about specific products and to feel the pulse of the market." The newsletter is backed with a lot of research so subscribers will have the meaning as well as the facts of the news. Sonny began his publishing company three years ago with the Monosson on DEC monthly focusing on in-depth reports. His second letter was Monosson's DEC-Compatible Buyer's Guide, which is a directory for users that catalogs third-party products and services in the DEC market.

Bob Bliss spent the fall and spring at Harvard and received a master's degree in education. He plans to teach science and math near his home in Georges Mills, N.H. Bob did his practice teaching at Cambridge High School and found teaching to be more demanding than he had anticipated. Several months after the last election, I learned that Bob's wife Nan had been a candidate for the New Hampshire legislature. Although Nan was not elected, she learned a lot and got to know the area. Probably she was too new and too democratic for Sunapee, N.H. After Bob's graduation in June, he and Nan toured Nova Scotia and Cape Breton National Park.—Marty Billett, Secretary, 16 Greenwood Ave., Barrington, RI 02806, (401) 245-8903

Margaret Coleman sends a report on results of our 35th reunion questionnaire. A more complete picture, including all the quirks and idiosyncrasies which make individuals interesting, will be included in the reunion book which is being put together at this time.

The average member of the class of '50 is a 57-year-old male, employed as an administrator in business or industry. His M.I.T. degree was from the school of engineering, and he has since earned an M.S. He has changed employers three times since 1950 but has changed fields only once. He has no patents to his credit and has published only one paper. "Publish or perish!" does not apply to private industry. However, the class does have an average of two patents and seven books or articles per person, but the distribution is very skewed.

Our typical classmate is still married to his first spouse and reports that his rapport with his wife is excellent. She is 55 years old and a graduate of a state university. They have three children, ages 23 to 30, but are not grandparents yet. Rapport with the children is very good, improving as the children mature. The net worth of the average classmate is about \$500,000. He earned between \$50,000 and \$100,000 last year. His spouse earned less than \$15,000. So much for the liberated women!

Although only 22 of the 196 alumni who returned a questionnaire had a child who attended M.I.T., our alumnus reports that if he were at student today he would choose M.I.T. again. He would probably elect the same course this time around, but might switch to course VI (electrical) or XV (management). In 1985, his first choice for college for a son, if he could choose, would definitely be M.I.T. He might also choose M.I.T. for a daughter, but is not so sure.

On a scale of one for liberal to six for conservative, the typical alumnus ranks Ronald Reagan a five. The alumnus ranks himself as slightly less conservative than the president and ranks his spouse as slightly less conservative again. He lists the worlds greatest problems in descending order as: the nuclear arms race, the population explosion, environmental decay, and the budget deficit. He would agree only to a bilateral verifiable reduction of nuclear weapons and believes that the U.S. should move forward on nuclear energy with deliberate speed.

The average class member reports that he spends his leisure time reading, playing golf, traveling, and working around the house and garden. His greatest assets are his intelligence, his ability to manage people, his solid family life, and his good health. His most important goal in life is to continue to contribute and to leave the world a better place. In the next ten years he hopes to continue to work and contribute and to make the transition to an active retirement with financial independence and peace of mind. His greatest concern is for the health and welfare of his family and for world survival. His greatest happiness is in his family, wife, and children, followed by pride in his accomplishments.

Robert L. Plouffe has been named executive vice-president of Contel Networks and Systems, by Continental Telecom, Inc. Contel Networks and Systems provide one-of-a-kind telecommunications systems designs, installations, and services to government, large corporations and institutions. He and his wife, Lois live in McLean, Va., and are the parents of three sons, Robert, Richard and Ronald. . . . **Frederick F. Sadri** informs us that he ran into **Stanley Bair**. Stan is doing well in his Houston Architectural partnership. In April, Fred and his wife, Martha, returned from two weeks in Russia. He found it most educational, plenty to see and, Fred says, that is the place to visit to make one truly thankful for the U.S.A. . . . **Kenneth H. Olsen** president, Digital Equipment Co., recently introduced a desktop version of the original refrigerator-sized

VAX, the Micro VAX II. The Micro VAX is a major high-tech development because it runs hundreds of programs available for the large VAX but at a fraction of the price. The Micro VAX is expected to cost less than \$20,000 but will come in models accommodating up to 16 users at prices as high as \$43,780. It is expected to be a favorite of scientists and engineers.

Your class secretary, **John T. McKenna**, senior vice-president, Boston Gas Co., and **James H. Lydon**, executive vice-president, Boston Edison Co., were two of the featured speakers at the Sheraton-Boston Hotel in February during National Engineers Week. . . . In May, **Alfred M. Petrofsky** was named executive vice-president of Jacobs Associates, a San Francisco based international consulting engineering company. He joined the firm in 1966, and from 1972 to 1975 he was located in Melbourne, Australia as chief construction engineer for construction of the Melbourne Underground Rail Loop Project, a rapid transit system. Most recently, his knowledge of worldwide underground construction brought innovative technology to San Francisco's Clean Water Program. Al's daughter and son are currently enrolled at M.I.T. He lives with his wife, Margaret, and their other two sons in San Rafael, Calif.

Will F. Nicholson, Jr., has been elected to the Fountain Valley School board of trustees for 1984-85. Fountain Valley is located in Colorado Springs, Colo. Will, a 1946 graduate of Fountain Valley, is president of Colorado National Bankshares. He is a resident of Denver. . . . **James A. Miller** continues to work for American Cyanamid Co., now at the Warners Plant in Linden, N.J. He is presently managing the installation and operation of computerized materials management and maintenance management systems. Jim is looking forward to the arrival of his second grandchild and also enjoys his Ph.D. son, who is busy doing research on aging and other intricate body functions. These two offspring keep Jim and his wife busy, flying hither and yon (one and two hours away as measured by time zones). Jim tells us that age has diminished his enthusiasm and physical readiness for downhill skiing, but he continues to struggle regularly around the golf course, wondering whether he can maintain or improve upon his 16 handicap. . . . We are sorry to announce the death of **Meir Drubin**. Meir passed away on April 25.—**John T. McKenna**, Secretary, 9 Hawthorne Pl., 10H, Boston, MA 02114

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Gerald Ikelheimer's company, Fibergilt Cases, Inc., has developed a new process, thermal in-verse moulding (M.I.T. in reverse), which has the ability to make parts with unlimited depth of draw and draw ratio, and internal ribs, bosses, and flanges at 20-25 percent lower energy and materials costs than thermoforming. That, along with a "leaking, 100-year-old stone house and two active sons" has kept Gerry and his wife, Charlene, quite busy over the years. . . . **William F. Steagall** consults on major defense system proposals like those related to the Strategic Defense Initiative. He races his 1963 Lotus 23, sails his Cal Cruising 36, and he and wife, Barbara, plan a Mexican cruise late this year. . . . **Colonel Francis J. Davis** is still doing strategic planning and contingency planning of telecommunications at Chase Manhattan Bank since his retirement from the Army Signal Corps as colonel in 1978. His oldest son, Paul, is a graduate of U.S. Military Academy (USMA), West Point, and is now attending medical college. Second son, Kelly, is back in school for his veterinarian degree. Third son, Chris, is a USMA now. Oldest daughter, Tracy, graduates Kean College in June (B.A. in theater arts). He also has two daughters still in high school.

Frederick G. Lehmann was recently appointed vice-president for institutional advancement at New York Medical College. . . . **David V. Ragone**

is president and director at Case Western Reserve University. . . . **Harold A. Siegel** reports his wife, Valerie, went back to school and became a Maryland lawyer in January. The firm of Siegel and Siegel is now in full operation in suburban D.C. . . . **Richard S. Valpey, Jr.** reports his oldest son completed postdoctoral work at University of Ohio, following up on his Ph.D. in chemistry.

. . . **Holt Ashley**, professor, Department of Aeronautics/Astronautics and Mechanical Engineering, Stanford University, Stanford, Calif. was reelected councilor by the National Academy of Engineering. The NAE is a private organization established in 1964 to share in the responsibility given the National Academy of Sciences under its congressional charter of 1963 to examine questions of science and technology at the request of the federal government.

Aaron Brody, manager of market development for Container Corp. of America is the co-author of a new book, *Principles of Package Development*, second edition. The book is published by AVI Publishing Co. of Westport, Conn. Brody resides in Devon, Pa. . . . In March 1985 **William J. Cavanaugh** was awarded a citation for his service to the Boston Architectural Center recognizing his long and dedicated service as an instructor in acoustics, participation in a number of committees, and his advisory expertise to thesis students. . . . It is with regret that we report the death of **Bryant Warren Foster** of Braintree, Mass.—**Gregor J. Gentleman**, Secretary, 600 Holcomb, Suite 1, Des Moines, IA 50313

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As I write this, it is high summer, and a mockingbird is singing. I should be content, but my vacation is nearly over, and I am torn by conflicting desires to fertilize the front yard or take a nap. Since napping is too degenerate, I shall finish this column instead.

I hope **James Weissburg** has relaxed this summer as he planned to do after his youngest child graduated from M.I.T. last June. Another son graduated from M.I.T. in 1977. If experience is the best teacher, M.I.T. must be a close second in the Weissburg family. Jim continues working as a consultant at Three Mile Island.

If **Jess Belser** feels like relaxing, he probably keeps it to himself. He recently became president of Rothschild Ventures Inc., a subsidiary of Rothschild Inc. Formerly he was executive vice-president of Continental Group, and president of Continental Forest Industries. There also may be less relaxation for **James Strawn**, chief geophysicist for Chevron Exploration. Recently transferred from Denver to San Francisco, he expects his work will increase because of Chevron's recent acquisition of Gulf Oil.

Our class and the architectural profession have been diminished by two deaths last spring. **Morton Hoppenfeld** died last March 26. He was a resident of Columbia, Md., a community for whose design he was responsible as director of planning and design for James W. Rouse and Co. Later, he was dean of the school of architecture and planning at University of New Mexico for five years until 1980. At the time of his death, he was senior vice-president of Enterprise Development, a Rouse subsidiary. He is survived by his wife and son, a son and daughter by a previous marriage, and a grandchild.

Robert Elliott died May 13. A resident of Lynnfield, Mass., he was tenant coordinator for Summer Schein, Architects and Engineers, of Brookline. He is survived by his wife.—**Richard F. Lacey**, Secretary, 2340 Cowper St., Palo Alto, CA 94301

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We are very sorry to have to report the death of **Alan MacKenzie** in early April. Alan was a chemical engineering consultant with Hull and Co. of

Greenwich, Conn. Earlier, he had worked for DuPont and the Pantasote Corp. before joining Hull and Company in 1970. Our sincere sympathy goes to his wife, Mary Lynn, and to his son and daughter.

Charles Smith sends regrets for missing the reunion last year. He was set to come when a last-minute business problem came up. Charles is with LTK Engineering Services of Philadelphia, consultants in the railway mechanical field. He had previously been with Conrail and its predecessors.

David Dennen writes that he is currently vice-president of biochemical development and biosynthetic operations at Eli Lilly and Co. He and his wife Jane have two daughters and a son. The latter, David, has just graduated from Culver Military Academy (in June).

How about the rest of you? Drop one of us a postcard with news, comments, whatever.—**Edwin G. Eigel, Jr.**, Secretary, 33 Pepperbush Lane, Fairfield, CT 06430; **Joseph P. Blake, Jr.**, Assistant Secretary, 74 Lawrence Rd., Medford, MA 02155

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As of your reading of these notes, our 30th reunion will be but history, history which has been separately reported to you by your reunion committee. For this writer, however, the reunion also brings to mind a number of images: the first greeting of classmates during the intermission at Pops on Thursday night. . . . the singing of the contemporary version of "Arise Ye Sons of M.I.T." thereafter. . . . subsequent meetings with old friends and learning new facts, for example that **Walt Rubin**, who is a professor of gastroenterology at the University of Pennsylvania, will have five children in universities this school year, four of whom will be in medical school. . . . tooling around Martha's Vineyard by bike and riding out to the airport for an air tour with **Glen Jackson**. . . . witnessing **Milon Essoglu** et al try (unsuccessfully) to talk **Lester Lee** into selling his freshman tie after dinner at the Vineyard. . . . viewing **Gene Davis's** sartorial splendor, including his preview of a 50-year blazer. . . . hearing of the exploits of Messrs. **Essoglu**, **Davis**, **Jim Storey**, **Pete Toohy**, **John Wing** et al both on the dance floor and in the swimming pool in the wee hours following the class dinner. . . . the return of the ferry from the Vineyard accompanied by the aerial tribute from **Glen** and **John Ackley**.

Mostly, the reunion was simply fun—nostalgic too—in that it represented the opportunity to renew acquaintances with **Dick Bergman**, who is still consulting and enjoying the good life in Princeton, N.J. . . . **Ed Elizondo**, who recently received his fourth degree, an M.S. in computer science from New Jersey Institute of Technology. . . . **Ella Paton Gardner**, who is a computer specialist in the Washington area. . . . **Margie and Lloyd Gilson**. . . . **Lester Lee**, whose activities in the investment world in Washington may include the purchase of a golf course. . . . **Bob Posner**, **Bobby** and **Jim Stone**, **Hal Stubing**, who, as is his wont, flew in from Cleveland where he is single-handedly keeping Bethlehem Steel in business. . . . **Ralph Wanger**, who continues to convert little acorns (the fund that is) to great oaks. . . . **Lenny Wharton**. . . . **Jerry Zindler**, etc. In sum, it was fun, and we hope to see the same faces and more at the 35th in 1990 (wow!).

Since our last communication, we have also received a number of other disclosures. First, for those in the vicinity of Claremont, N.H., we understand that **Stanley Barriger** opened a travel agency, **Ascutney Travel, Inc.**, in Claremont earlier this year. Stan received a master's degree in transportation from Yale, and has since set about seeing the world, having visited some 90 countries, including a stint as a travel agent in Rio de Janeiro for two years. Stan has lived in New Hampshire for the past 15 years, where he has taught world geography at Hesser College and has lectured at many other colleges. Sounds like

an interesting life!

John Morris Dixon, the editor of *Progressive Architecture*, who is not a stranger to this column, has received a Neil Award for editorial achievement for an editorial last year, addressing the "American Dreams" of single-family homes. John has been a resident of Old Greenwich, Conn. since 1972 and is a fellow of the American Institute of Architects. His wife, Carol, is chairperson of the history department at Greenwich Academy, teaches art on the faculty of the Stamford Museum, and has been active in several area art organizations.

We also learn why **Paul Mosher** failed to show up at the 30th reunion. Apparently Paul has busied himself with the affairs of the San Diego-based Kelco Division of Merck and Co. Kelco produces xanthan gum and alginates, materials which are widely used as thickening agents and stabilizers in foods and drugs. Paul joined Kelco in 1962 as a development engineer, and has steadily moved up the corporate ladder, being named General Sales Manager in 1970, vice-president of international operations in 1978, vice-president of marketing in 1979, and senior vice-president in 1981. On May 1 he was appointed president of the division. Congrats!

We also have a recent letter from **Roger Reiss**. Roger reports that he too has moved west, and is currently a senior staff engineer in the electro-optics field for Aerojet General in Azusa, Calif. Roger (is it still "Buddy?") lives at 391 Calle Alcazar, Walnut, CA 91789. He welcomes contacts from you out there, particularly from **Jim Abrahamson** (who may be too busy with Star Wars these days), **Gary Brooks**, **Don Wint**, or **Bob Duncan**.

We also have a brief note from **Allen Wahlberg**, who reports that he is keeping busy as a second-term councilman and liaison to the planning board in Ho-Ho-Kus, N.J. Al still finds time to spend summers boating and fishing at his home on the Jersey shore.

Your co-secretaries are about to call it a day (specifically, ten years in the case of your New York correspondent and 25—or is it 50 years, Alan?) in the case of your Massachusetts correspondent. The New York half of this team would but note that I have enjoyed receiving your letters and serving as a focal point, and look forward to our continued contacts and reunion get-togethers. I leave it to my distinguished colleague to set forth our valedictory in next month's column in his inimitable manner.—Co-secretaries: **Marc S. Gross**, Winding Rd. Farm, Ardsley, NY 10502; **Allan C. Schell**, 19 Wedgemere Ave., Winchester, MA 01890

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Lloyd Brace (industrial management) has become a senior associate in John Christie Associates, a consulting firm in Augusta, Me. Lloyd's career includes being the first director of finance at the Maine Development Foundation and the first manager of the Maine Capital Corp. In his new position, he will provide start-up support for clients launching new products and services. . . . **John T. Coleman** (mechanical engineering) informs us that he is working for the Boeing Military Airplane Co., and that his son Edward graduated from M.I.T. in mechanical engineering, with an S.B. in 1984 and an S.M. in 1985. . . . **S. Hoyer-Ellefson II** (mechanical engineering) sent the following note: "This is useless. They never published anything before when I sent in info.!!" (Now, now, Sigurd, that is the wrong attitude. As you see, we try to be responsive, and your note is being published.) According to the 1984 *Alumni Register*, Dr. Hoyer-Ellefson is vice-president of the Servo Corp. in Hicksville, N.Y., and resides in New Canaan, Conn.

Nicholas Melissas, '52, donated \$1,000 to the M.I.T. Alumni Fund in memory of **Jakob Auslander** (ocean engineering). Jakob died on February

5, 1985 in Haifa, Israel. According to the 1984 *Alumni Register*, Jakob was a senior naval systems engineer for the Rafael Armament Development Authority of the Israeli Ministry of Defense. I remember Jakob as being one of the strongest and most vigorous members of our class and am saddened by the news of his passing.—**Robert Kaiser**, Eastern Co-secretary, 12 Glengarry, Winchester, MA 01890, (617) 729-5345; **Caroline D. Chihoski**, Western Co-secretary, 2116 W. Davies Ave., Littleton, CO 80120 (303) 794-5818

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Fall is coming—indoor time. So y'all take out your pens, word processors, stone chisels, or whatever it is you write with (or phone me), and help me let your classmates know what you are up to. Talk about travel, kids, hobbies—any kind of personal stuff—as well as new jobs and professional recognition. If it's what you are into, just talk about the help you need raising bail. Otherwise I shall have to resume expressing my views on important social topics. For instance, I believe capital punishment. . . . **Richard Weiner** reports he is a partner with the 24-lawyer firm of Bolger, Picker & Weiner, in Philadelphia, at which he specializes in corporate, securities and real estate law. He and wife Barbara (an interior designer) live in Jenkintown, Pa., with sons Matthew, 15, and Andrew, 10. He would like to get together with some old classmates, especially from A E Pi; please phone him (215-885-0812, eve.), as he has lost contact.

Now here is something practical: the Vanguard (TM) Electronic Cavity Detector. It finds very early cavities in teeth, especially in children and young adults. I tell you this because it was developed by our own **Mark Douma**. To find a nearby dentist using one of these gadgets, write Mark, at 308 Pearl St., Cambridge, MA 02139.

Dan Greenwald is president of a three-county chapter of the New Jersey Psychiatric Association, living in Highland Park, I believe in the Newark area.

"For my west coast friends," writes **Ken Klein**, "my new address in 1080 Club Place, Atlanta, 30319." He does not so advise his east coast or middle-American friends, so I won't either. Ken does tell us all that he has formed his own company, called Softpedal, Inc., engaged in computerization services for the media.

Michael Greata is, if I understand the pithy printed announcement correctly, a director of Imaging Technology, Inc., and vice-president for new ventures of Apollo Computer, Inc. He lives in Prides Crossing, Mass.

I have a lengthy press release about **Steve Benton**, who is involved in 3-D imaging and other aspects of optics and electronics. He is an associate professor at the Tute, president of the New England section of the Optical Society of America, and fellow of that Society and of the Society of Photographic Scientists and Engineers. He lives in Lincoln, Mass.—**Phil Marcus**, Secretary, 2617 Guilford Ave., Baltimore, MD 21218, (301) 889-3890

64

Greetings from Washington, D.C. I have completed my move and am rapidly learning a lot about the local commuting traffic patterns. So far, the infamous Washington heat and humidity hasn't been too bad—but it's only June.

This month's column contains items from a diverse collection of sources, including the inside pocket of one of my summer suits. As you recall, our 20th reunion was one year ago; during the dinner dance, several people said "hello" and gave me their business cards. Those cards were lost for the last year but have just turned up. I don't remember any of the accompanying words, but I'll pass along the information as printed on the cards.

Dave Bivins is employed in New York as the vice-president, finance and administration of the NBC television network. With the recent improvement in NBC's ratings, that has to have become a lot more pleasant job. Dave and his wife live in Princeton Junction, N.J. . . . **Mike Godfrey** is living in St. Louis, Mo., and is employed by the Missouri Pacific Railroad Co. as manager of transportation planning. Maybe Mike and Dave will be kind enough to send along some more recent news.

A news release from System Controls, Inc. in Palo Alto announced that **Bob Ratner** joined Systems Control as senior vice president, systems group. Previously, Bob has been with SRI International. After leaving the Institute, he earned master's and doctoral degrees from Stanford University in electrical engineering.

The New England section of the AIAA recently held an election; the ballot included biographies of the candidates, one of whom was **Dave Stickler**. After receiving his S.B. and S.M. from M.I.T. in 1964, he went on to earn a Ph.D. in propulsion in 1968. Dave is employed at the AVCO Everett Research Laboratory where he is currently chief scientist of the energy technology office. His recent activities have focused on combustion and reacting fluid flows in various energy applications. Previously, Dave taught in the aero and astro department at the Institute.

This month's final item is an announcement clipped from an M.I.T. newspaper that **Margaret MacVicar** was elected to the board of directors at the Exxon Corp. She is professor of physical science and the Cecil and Ida Green professor of education at the Institute. Margaret founded and is director of the M.I.T. Undergraduate Research Opportunities Program (UROP). As an Educational Council member, I've had the chance to spend time at the Institute talking with students. For many of them, participation in UROP is the highlight of their educational experience.

At this point, the clipping file is totally empty. Please drop a line, or if you're in the Washington area, give a call.—**Joe Kasper**, Secretary, 3807 Benton St., NW, Washington, DC 20007

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James Cronburg cheerfully reports that on June 15 he found himself in the delightful position of marrying Janet Lynn Serman, formerly the director of graduate programs and now the New England regional director of the M.I.T. Alumni Association. . . . **George Starkschall's** second daughter, Andrea Debra, arrived last November. George has been promoted to associate professor of radiation therapy at the University of Kansas Medical Center. . . . **Larry Taggart** has been named president of Bunge Edible Oil Corp. in Fort Worth.

D. Travis Engen has been appointed president and general manager of the ITT Avionics Division, Nutley, N.J. He was previously with Allied Corp/Bendix in Ft. Lauderdale and Republic Electronics in Melville, N.Y. . . . **Frank March** President of Seaward International, Inc., Falls Church, Va., has completed a nine-week Harvard Business School executive program for owner-presidents of companies having at least 40 employees and annual sales between \$3 million and \$75 million.—**Jim Swanson**, Secretary, 878 Hoffman Terr., Los Altos, CA 94022

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The mail has been rather light of late, but we'll report what we have. Our own big news this month is that Gail has taken a position at the U.S. Nuclear Regulatory Commission as director of the Policy, Planning, and Control Staff in the Office of Nuclear Regulatory Research (government job titles are always such a mouthful!). The job looks like it will be hectic but fun.

Had news from several other Washington area

folks this month. **Stephen Straus** reports that he is a virologist at the National Institutes of Health. His wife Barbara is getting her master's in educational counseling and helping raise their three children, Kate (7), Julie (5), and Benjamin (2). Or rather, he says, "I'm helping her!" . . . **Dennis Sager** is still in private practice as an internist in Reston. He also still works as an engineer a couple of hours a week when he can at MITRE on air traffic control. Child number 4, Jill Rene, was born September 20, 1984. . . . A recent arrival in the Washington area is **David Coomber**, who took a position with M/A-COM Linkabit as director of Communications System Development. He was recruited here by **John Capetanakis**, who is assistant vice-president for engineering.

From elsewhere, we hear that **Timothy Johnson** joined General Electric Corporate R&D in May 1984 and the family moved to a new home in Schenectady. In April 1985 he was appointed manager of the Control Systems and Architecture Program in the Control Technology Branch. . . . **Eric Schuetz** writes that he is in the process of relocating from San Francisco Bay area to Atlanta and will write more when settled. (Since this column was written in June, he hopefully is settled by now.) . . . **Shirley Jackson** has been selected as one of America's top 100 black business and professional women by *Dollars and Sense* magazine and Delta Sigma Theta Sorority. . . . **Richard Rudy** was reelected president of High Tech Gays, a professional organization, and is serving on the board of directors of BAYMEC, a political action committee promoting gay rights issues. He is also writing theatre reviews for a local newspaper.

In something of a first us, **Donald Baker** writes that he is currently looking for employment in microprocessor applications (6809, 8088, 68000), in a non-smoking workplace. Anyone interested can contact him at 1700 Ross Ave., Springdale, AR 72764, or (501) 751-7979. We look forward to hearing a successful conclusion to the job search, Donald, and please let us know if the contact originates from this column. Who knows, we may have a whole new career ahead of us! . . . Finally, on a sad note, we received news of the death of **Paul Maguire**. No details are available.

Please drop us a line to let us know the latest and greatest in your careers and personal lives—or just to remind us all what you have been doing the past few years.—**Gail and Mike Marcus**, 8026 Cypress Grove Ln., Cabin John, MD 20818

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Before we dash out to hear the Beach Boys (shades of Spring Weekend 1966!) perform amid fireworks near the Washington Monument, I thought it would be fun to catch up on these notes. **Tom Imrich** writes from Mercer Island, Wash. that he is currently on M.I.T.'s Department of Aeronautics and Astronautics visiting committee and has spent a considerable amount traveling to M.I.T. for the past meeting (all the way from Seattle). Tom, is that time or money? . . . All you inventors take note, **Robert Barr** is now practicing patent law with the San Francisco firm of Townsend and Townsend. . . . **Michael J. Ginzberg** writes, "After ten years in New York, I'm finally moving West! Joining the faculty of Case Western Reserve University, Weatherhead School of Management. Matthew (age 3) will now have a tough choice, M.I.T. or C.W.R.U." . . . **David Frank** has been elected vice-president and treasurer by the board of directors at the American Can Co. of Greenwich. He has been with the company since 1977.

Vincent G. Mace is now a senior officer of Massachusetts Mutual Life Insurance Co., according to a brief note in *The Daily News* of Springfield, Mass. . . . **Roger Chang** writes, "After being promoted at Westinghouse Defense, I supervise over 30 contracts and tasks in electronic warfare. I also got elected president of local Old Crows Roost, a professional electronic warfare or-

ganization. As an Old Crow, I'm going to have to learn to flap my wings and fly!" (Make sure the building isn't too tall!) . . . **Peter Hirz** writes, "I am in management with I.B.M. I am serving Jesus Christ as a teacher and elder in my church. I am living in Boca Raton, Fla."

In news from the National Academy of Engineering, we hear that **Robert Swanson**, founder of Genentech and its current president, spoke before a symposium on economics and technology at Stanford in March. He said that United States export regulations for new drugs are the most strict in the world, meaning a loss of business and a lost opportunity for helping to restore the U.S. balance of payments. . . . **Stephen Flanders** has just observed his tenth year as a researcher of switching thermal performance at the U.S. Army Cold Regions Research and Engineering Laboratory in Hanover, N.H. . . . **Ronald Lau** is now with the Measurix Corp. in Cupertino, Calif.

I'd best close now to see the "bombs bursting in air." By the way, it is a real novelty being able to buy personal fireworks around here, something definitely very criminal in Massachusetts and Connecticut. Brings back memories of a gunpowdered youth, when the infernal crackers were still allowed.—**Eugene F. Mallove**, 11902 Paradise Ln., Herndon, VA 22071

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Raymond Kurzweil, through Kurzweil Implied Intelligence, Inc. of Waltham, has announced a new integrator circuit that represents an important step towards large vocabulary computer recognition. This circuit is a key piece of hardware in an effort to produce a practical voice-activated typewriter. . . . **John Light, III**, recently married Rita Kirby and is living in Hickory Corners, Mich. John writes that he is still the Lights Tree Co. in Richland, Michigan. . . . Recently received a letter from **Sue Winard**, M.D. in which she indicates she joined a private practice group specializing in radiation oncology at St. Luke's Hospital in Bethlehem, Pa. She continues to love her work and writes poetry on various topics including medicine. She writes that she is a member of the American Physicians Poetry Association and has been published in the *Philadelphia Medicine*, *Pennsylvania Medicine*, and *The Journal of American Women's Association*.—**Robert O. Vegeler**, Secretary, Dumas, Backs, Salin, and Vegeler, 2120 Ft. Wayne Natl. Bk. Bldg., Fort Wayne, IN 46802

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Grethe Holby writes: "My production of *Faust* appeared on national public television on April 7. Also just directed the world premiere of Persichetti's opera, *The Sibel* in Philadelphia and the American premiere of Werle's *Animalen*, the production that opened the new Ordway Music Theatre in St. Paul, Minn. (Currently working on a new opera with a Ford Foundation grant. . . . **Rene Manuel Haas** writes: "I, my wife Sharon, and son Jason (2) are doing well. A second baby is on the way and due in November. We are building a new home in nearby Franklin Lakes and expect to move in July."

Hugh H. Sprunt, Jr. writes: "Became a tax partner with KMG, a large international account/consulting firm April 1, 1985 (a date not without some irony). Continue to be married to Eve S. Sprung, Ph.D. (M.I.T. S.M. and S.B. '72), a state that requires due diligence." . . . Congratulations to **A. Warren Lippitt**, who had a son Seaver Burke Lippitt, on September 6, 1984 and to **Daniel R. Lynch**, who reports a lovely daughter, Maureen, was born on December 24, 1983.

Don't forget that our 15th reunion will be celebrated in 1986. Save your money and come to Boston for the celebration. I hope that all of you who live in the area will come up with some great ideas for the celebration. My family is looking forward to coming.—**R. Hal Moorman**, P.O.

73

Either there is a postal strike on, or there is a mysterious disease striking members of the class of '73 paralyzing their fingers. One way or 'other, ain't but two things to write you about.

Dr. William Stern is now chief of gastroenterology at Shady Grove Adventist Hospital. The note doesn't say what state or city that's in, but it must be within commuting distance of a school, since his wife Sara is a school psychologist. They have gone forth and multiplied, producing two children (gender also unspecified), Bezalel and Noam. . . . A copy of the *Reflector* forwarded me mentions a gentleman who was the very first classmate I met at M.I.T. way back on that first scary day. **Tomas Lozano Perez** followed the ladder of academia in Course VI all the way to his Ph.D. in 1980. Following that, he joined the electrical engineering department itself, where he is currently an associate professor. His interests are in the fields of robotics, AI, geometric modeling, and a host of other related items.

Simon, our immigrant Bulgarian, is in the middle of layering tons of what appears to be stucco on the outside of our house in an effort to make it look Tudor. Well, it's half way there—it's already a wonder. (Anyone who got that knows why Good Queen Bess was greater than Joan of Arc.) We would rather have no more of these barren, pun-littered articles, so write, darn ya, write.—**Robert M.O. Sutton, Sr.**, Secretary, Chapel Hill, 1302 Churchill Ct., Marshall, VA 22115

74

Ah Boston in the summer! The esplanade fills up with sun worshipers. The Charles fills up with sailboards and sailboats. This is the weather we wished for desperately last February.

Class president **Sandy Yulke** has joined the M.I.T. Industrial Liason office, which ought to be a breeze for her considering *Sandy knows everybody*. . . . The latest word from **Larry Bell** has him living in Beaver Falls, Pa. with wife Kathy and son Elliot. Larry is now a full-time orthopedic surgeon with a special interest in hand surgery. . . . **Bill Young** is now Major William D. Young, U.S. Air Force, after a recent promotion.

I've received two rather garbled notes from the alumni association with news on two classmates. Please write me directly with the real scoop as I try to reproduce them here verbatim. **Marcia Weisman** had a son, David Eric, on December 31, 1984. She is working as a "brosatrdreiem" at Ayerst Laboratories. Sounds very high-tech. The note from **Robert Roth** says something about Emory University and basketball coach but the rest got garbled by the copy machine. Help!

I myself have some news. In April I took off for Salt Lake City on my motorcycle. It took my 11 days to get there, and aside from the tornado in Nebraska, the hail storm in Wyoming, and the snow storm in Utah (and the flat tire in Ohio), the trip out was uneventful. Saw fellow Fiji **John Sitarski** and his beautiful wife Caroline in Park City. She was twice equestrian Grand National Champion in her teens and is getting back into shape for the amateur circuit. They hope to have their garage built before the winter snows.

Allen J. Seltzer wrote that he's vice-president of USSi, a software company in McLean, Va. Number one daughter Miki Sarah arrived in April, and he's looking for golfers in the D.C. area. . . . **Scott Peterson** is now a patent attorney with Wang Laboratories. . . . **Leonard Roberts**, as of June 1984, has been director of the Department of Information and Revenue (Bits and Bucks?), Seattle Municipal Court. . . . From the wilds of Atlanta comes a note from **Donald Higgins**: "I am developing software for Harbinger Computer Services, Inc., a firm offering banking and shop-

ping services via personal computer. I am married and have two sons, Jesse (5) and Max (2).

Ted Kochanski is back living in the Boston area. He writes, "Recently left the world of academic research (read: unfunded) for the challenges of defense research." He goes on to refer to Boston as "the boom town of the eighties." (Which it is.) Ted's now on the research staff at Lincoln Labs, working on radar. . . . **Judith Falows** and **Adrian Gropper** share a daughter, **Adrianne Groper, Jr.** (aka Ada). "Ada is currently enrolled at Harvard since M.I.T. does not accept people under 2."

And finally, an article in the Harvard University *Gazette* headlines the fact that **Stephen Kent**, assistant professor of astronomy, has been awarded a Presidential Young Investigator Award from the National Science Foundation, giving him a stipend for basic research for the next five years. Stephen is quoted in the article as saying of his grant: "It will provide for the cost of doing research, travel, expenses, meetings, and assistance. It's amazing how fast it disappears." Stephen studies the structure and internal motions of galaxies, and he also teaches a course in the graduate school.

It's October now and time to make your Christmas home-for-the-holidays plane reservations. Write me that newsy letter you've been putting off for the last 18 months.—Co-Secretaries: **Lionel Goulet**, 21 Melville Ave., Dorchester, MA 02124; **Jim Gokhale**, 45 Hillcrest St., Arlington, MA 02174

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The 10th reunion of the class was held in Cambridge, June 7-9. Dare I say that a good time was had by all. For those who didn't attend, you were missed and I hope you can make it next time. I'd like to extend special thanks to **Margo Levine** for bravely and successfully chairing the reunion committee. She personally handled many of the detailed arrangements which helped make the reunion a success.

The reunion program began Friday night with a roving cocktail party which temporarily came to roving in the McCormick Country Kitchen. A pleasant and informal air continued through a buffet dinner, and later in the Green Room next door. It was the first opportunity for many of the class to recognize and be recognized after as many as ten years away from the Institute.

The Saturday night event began with an unscheduled bus tour of Boston, eventually arriving at the Boston Tea Party Ship, the *Beaver*. The night air was clear and cool, near perfect for an outing at the waterfront in early June.

Sunday's brunch was another mobile activity. To everyone's surprise, including the alumni officials, the Hayden Gallery had recently been moved to a newly-constructed building on east campus. nonetheless, the brunch was held in the courtyard between Walker and the Hayden Library. Again, the weather was ideal. **John Chisolm** offered a delightful and amusing reading of an epic poem he wrote over a ten-year span. John's impassioned recount of the foibles surrounding a math problem set were masterful. Astrophysicist **Rick Shafer** was the only one brave enough to answer John's question, "What time is it 12 hours after midnight?" (Answer below.

Think of this as an adjunct speed department problem.) Class business was also taken up, including the election of new class officers: **David Wargo**, president; **Charles Fendrock**, vice-president/treasurer; and **Jennifer Gordon**, secretary. Dave recently left State Street Research & Management to start up a new investment management concern in Boston. Charles continues to pursue R&D interests at Symbolics, Inc. in Cambridge. Jennifer, who kept us all informed as class secretary until 1980, is currently studying for the bar exam in New York. She's studying so hard, in fact, that this column is being written by me (otherwise known as **Richard McCarthy**). After the

July exam, Jennifer plans to take a well-deserved vacation in Europe.

In other class business, it was decided that any minor surplus funds in the class treasury, after settling reunion expenses, would be donated to the Class of 1975 Scholarship Fund instead of slowly eroding in the bank. In case you've been travelling through deep space, our class has demonstrated its commitment to the Institute and to future M.I.T. classes by establishing the above endowment fund. The generosity of the class to date has resulted in gifts totalling over \$31,000, and is quickly approaching the \$35,000 "triggering" level necessary to make the scholarship fund a reality. This is only the beginning, so I urge you to be generous and to designate the Class of 1975 Scholarship fund in your annual pledges to M.I.T. Our thanks go out to **Peter Mancuso**, class agent, for his work with M.I.T. to establish this class gift.

Reunion attendees or those planning to attend included (my apologies for errors or omissions): **Dave Strauss**, **Henry Heck**, **Rick Stadterman**, **Ed McCabe**, **Tom Jacobs**, **Jeff Bokor**, **Barry Weinstein**, **Dave Wargo**, **Brian Jaski**, **Frederick Blackall IV**, **Kevin Hunter**, **Robert Weinberg**, **Sherman Wang**, **George Tremblay**, **David Sieverding**, **Christine Plapp Lofgren**, **Charles Fendrock**, **Mark Hurwich**, **Andrij Neczwid**, **Henry Leftman**, **John Chisolm**, **Robert Halstead**, **Carol and Roy Greenwald**, **Norris Priyer**, **Edward Saad**, **Rick Shafer**, **Rob Fazio**, **Christine Cowan-Gascoigne**, **Miles Fiedelman**, **Eric Schaffer**, **Margo Levine**, **Jim Moody**, **Stephen Chapman**, **Storm Kauffman**, **Susan Fuhrman**, **James Demers**, **Joseph Jones**, **Elizabeth Lund Zahniser**, **Leonard Weiss**, **Eric Kushnick**, **Mindy Tai**, **Fonda Thompson**, **Peter Balnshan**, **Roger White**, **Fred Hutchison**, **Donald Shobrys**, and **Noreen Hickok**.

Random rumors and bits of news: **Jim Demers** recently purchased a co-op on Manhattan's west side. Jim works at Ortho Laboratories in New Jersey. . . . **Alex Castaldo** has been diligently working at Software Research Corp. in Natick, Mass. SRC recently obtained additional investment capital and their initial software package is about to be introduced. . . . **Christopher Dippel** has been appointed by the M.I.T. Industrial Liaison Program to the position of liaison officer. He is expected to work primarily with biological and biochemical concerns. . . . **Edward W. Capparelli** writes "I continue to do medical missionary work among the Miskito Indians in eastern Honduras. I was recently elected medical director of the mission work there and serve on the regional health planning board of the Honduran Ministry of Health. My wife Gillian (Middlebury '75) and I had a son, Daniel Blauvelt, on March 20, 1985. We also have a three-year old daughter, Elizabeth. . . . **Tom Jacobs** and his wife, Sharon Gardner ('79), enjoy a new addition to their family, Will Gardner Jacobs born April 5, 1985. Tom works for New England Telephone in Boston as a systems analyst. Tom and Sharon bought a house in Salem, Mass., in June. . . . **Khadijah Abdus-Sabur** and her husband, Muhammed (M. Arch, '78) have started a design/building firm in Washington, D.C. called Design & Development Ltd.

Jim Moody, a lawyer with the Capital Legal Foundation in Washington, D.C., is embroiled in the sensitive issue of whether or not to shrink-wrap lemons and other citrus. Shrink-wrapping lemons supposedly extends their shelf life up to nine months instead of just a few weeks. . . . **Charles Fendrock** recently purchased a house in Sudbury, Mass., and now enjoys the joys of household maintenance, especially raking leaves. . . . **Rick Granger's** name was taken in vain by several at the reunion. How about an update, Rick? . . . As for myself, Judy and I moved into a house we had built in Windham, N.H., in March. We are expecting our first child at the end of September. I'm still doing energy and electronics consulting at Arthur D. Little and travelling quite a bit. In fact, I flew straight through from Jakarta, Indonesia, to Boston the day before the reunion.

The class mailbag is far from overflowing with



Diane Curtis, '78, and James L. Bidi-gare, Jr., '78, were married in May and stopped at Killian Court for pictures. Diane and Jim did not know each other while attending M.I.T.—they met while planning their 5th reunion. Alumni activities can be very rewarding, says Diane.

news, so please make an effort to send Jennifer an update on your activities as well as those of the classmates you stay in touch with (otherwise, we'll be forced to start making things up). SD answer: noon.—**Richard McCarthy** for **Jennifer Gordon**, Secretary, 18 Montgomery Pl., Brooklyn, NY 11215

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The mails have provided us with some news. Hurrah! First of all, **Stuart Morgan** acquired a master's in architecture at the University of California at Berkeley and has remained on the West Coast since then. After doing some teaching at Berkeley and working for a string of well-known architectural firms such as Skidmore, Owings, and Merrill, he has started an architectural partnership, Kaplan/Morgan Architects, in San Francisco. He was recently visited by a fellow alumnus, now Dr. **Lawrence Moss** from Los Angeles. He is doing very well and has recently started his own medical practice as a psychiatrist. Stuart is also engaged to be married to Catherine H. Flint, who is originally from Maine. They are currently residing in the North Beach area of San Francisco. . . . **Gregory Allen** is now "practicing radiology at Oakland Naval Hospital in Oakland, Calif." . . . **David Leighton** "was just promoted to senior programming staff specialist at Aerojet Electronics."

Kudos to Dr. **David Gifford**. David has just been appointed the IIT Career Development Professor in Computer Technology, a two-year appointment, at the 'Tute. Dave is the leader of a research group at the Laboratory for Computer Science. After finishing the 'Tute, he did his graduate studies at Stanford on decentralized information systems before going back to M.I.T. His specialty is database replication techniques and algorithms for cryptographic information protection. . . . Dr. **Kenneth Davis** writes that he

remains in pediatric practice in Elizabeth, N.J. "My partner and I have bought and are currently renovating an office building." . . . **Daniel Christman** is continuing "my active participation in several community orchestras. This year I also joined a concert band and church choir. At the end of April, I attended the Founder's Day weekend celebrating the 100th anniversary of the founding of the Delta Chapter of Theta Xi fraternity. Over 100 alumni were present, including **Rich Chmura**, **Stewart Mehlman**, **Mike Dziekan**, **Ken Davis**, and **Doug McKillip** from '76." . . . Congrats to **Michelle** ('78) and **Gary Buchwald** on the birth of their third child, a girl.

As for your secretary, the foreign exchange and bond markets continue to supply plenty of hair-raising action. I have gained a few more grey hairs over the last few months from the volatility. On a less pressured note, Rita and I will be vacationing in Israel for two weeks. While in Jerusalem, I hope to look up several of our classmates who moved to Israel, as I will be writing the Nov/Dec issue of the notes from Jerusalem.

Please do write—we desperately need some news. As a matter of fact, I have heard *nothing at all* from approximately 500 of our classmates over the last nine years. Surely, a letter to me nine years after leaving the 'Tute is due. Write.—**Arthur J. Carp**, Secretary, 110-07 73rd Rd., Forest Hills, NY 11375; (718)544-5136

77

We start off this month with a note from **Michael Cohen**, who is leaving government service after four and one-half years as a trial attorney for the IRS to join the Beverly Hills law firm of Trachman and Goldner, specializing in tax litigation and planning. Michael says he is still single "having survived a few close calls" and loving every minute of it. . . . **Bruce Ruotolo** is consulting in factory inspection instrumentation, vision and scanners, and may move back to Boston if his venture plan receives financing. . . . **Louis Essandoh**, M.D., graduated from Yale Medical School in 1981, did his residency at the Mayo clinic, and is now a fellow in cardiology at the Mayo clinic.

Melinda Zwickert is still with Hercules Inc., in Wilmington, Dela. Melinda began at the research center, moved into the marketing group in technical services, and is now a product supervisor in polymers and additives. Melinda married Steve in 1978, and Steve works for National Gypsum Co. Melinda and Steve have a daughter, Elizabeth, born February 26, 1982. . . . Dr. **Steven Oblath** and his wife Deborah are expecting their second child this August.

Dr. **Jeffrey Swalchick** is finishing his internal medicine residency at San Diego Naval Hospital. Jeff's wife is expecting a baby, and they are headed off to Yokosuka, Japan for two or three years while Jeff serves the navy as a general internist. . . . Dr. **Marc Reitman** received his M.D. and Ph.D. degrees from Washington University, St. Louis, in 1983, and is now two-thirds of the way through his internal medicine residency at Columbia-Presbyterian Hospital, N.Y. . . . Dr. **Nina Cahan** is in family practice, including obstetrics, in a suburb of Dallas.

Howie Boles is currently working at Spinnaker Software in Cambridge, writing music and musical software for home computers. Howie is also still active in community theater, having just finished directing a production of the musical, *Chicago*. Lisa and Howie bought a house in Marlborough last year and are enjoying it very much. . . . **Deborah Hoover Dobson** is still living in Houston and working with the subsea oil systems group for Exxon. Their oldest son is finishing kindergarten already, and his younger brother is only a few years behind. Deborah enjoys keeping in touch by getting back to campus for recruiting trips and the ocean engineering visiting committee.

Well, this was definitely a good month for mail, particularly from our doctors in the class. Let's

keep it up, and hear from each of you soon. Thanks for writing.—**Barbara Wilson Crane**, Secretary, 6431 Galway Dr., Colorado Springs, CO 80907

78

There's a lot of news this month, so let's dig right in. We have a couple of new professors: **Jeanette Wing** writes "After two years of teaching at U.S.C. in L.A., I'm heading back east to Carnegie-Mellon Univ. in Pittsburgh as an assistant professor in the department of computer science. Living in West Hollywood exposed me to the sleaze of Hollywood, the poshness of Beverly Hills, Melrose Ave. high-tech punk, and a quiet community run by a predominantly gay city council. Jazz dancing is big in L.A., but I'm still stuck on ballet. It's all been fun, but I'm looking forward to the four seasons and being closer to N.Y.C. and Boston." Our other new professor, **Leslie Federer** is now a tenure-track assistant professor in the Oklahoma State math department. Leslie has also received an N.S.F. post-doc fellowship to fund her research.

New family members; first babies: **Katherine Rozanski Eisenberg** and her husband Richard wrote to "proudly announce the arrival" of their son David. (I approve of the name.) I also got a card from **Dave Leblang** to announce the birth of Amy Beth.

The other new family members are new husbands and wives, and we have a whole truck load this month. In no particular order, let's start with **Carl Krasniak**, who is now a senior resident in general surgery at University Hospitals at Cleveland. Carl got married in May to Lidia Telesz; they spent a four week honeymoon in central Europe, including Poland, Austria, Switzerland, Yugoslavia and Italy. **Carrick Davidson** and University of Texas law school classmate Jennifer Brooke celebrated the end of the bar exam by getting married (and honeymooning in London). Carrick will be working in Washington D.C. at the U.S. Dept. of Justice in the environmental enforcement section. (Carrick reports that **Joel Mandelbaum**, still in N.Y.C. has left Lehman Brothers for Dacompt, Inc.)

In response to my threat of writing dastardly lies about him, **Milt Royce** sent me a note about his June wedding to Harvard Business School classmate Gloria Lara. Milt writes that he has "finally gotten my unconditional parole from Dayton, Ohio. I am now a wolverine, working for a recently reorganized GM component division. I'm working in financial planning, where I'm plotting ways for us to once again take GM over." Gloria, another car buff, works for Chrysler.

Bernard Kempinski wrote to announce his February marriage to Arria. Bernie is working as a research staffer for the Institute for Defense Analysis. Bernie and Arria live in their new house in Burke, Va. Also, I got a note from **Carol Pokodner Power** to announce her January wedding to Daniel Power. Carol is a Senior Business analyst at Bendix Field Engineering Corp.; Dan is professor at University of Maryland.

A great note from **Matt Lief**: "At the ripe old age of 32, I have committed matrimony with the former Susan Victoria Cohen of Philadelphia. We have purchased a house in Cheltenham, a close-in suburb just north of the City of Brotherly Love." Matt is working for The American Society for Testing and Materials "riding herd on eight technical committees" responsible for publishing thousands of voluntary standards each year (about 7,000 of them in 66 volumes). Matt waxed eloquent about Philadelphia's "homely, unaffected charm and gritty, vibrant vitality that combine to produce a most liveable ambience." He adds, "Try to find someone to badmouth Philadelphia who has actually lived there."

For the last (but certainly not least) of this month's marriages, there was class president **Jim Bidigare's** wedding to classmate **Diane Curtis** in

Cambridge this June. Those guys went all out: first, there was the boys choir at the church; then dinner and dancing at the New England Aquarium. (They skipped the dolphin show.) Classmates at the wedding (besides wife and myself) included best man **Ricky Ewasko**, **Al Presser** (and wife Dorothy Anderson), **Gene Allen** (recently out of the navy), **Milt Royce** (and fiancée Gloria), **Al Chock** (and wife Bonnie Mason '79; they just bought a house in Melrose, Mass.), class agent **Dave Woodruff** (and wife Denise), **Catherine Chiles**, **Don Lapin**, **Wendy Wofe** and **Cheryl Bunker**. Jim and Diane honeymooned for three weeks in France.

Paul Maki writes that he is "resurfacing after several years of immersion in graduate studies in E.E. at Cornell. I expect to complete my Ph.D. this summer. I will certainly miss the gorges, wineries and Finger Lakes. . . . **Bernie Alpern** and his family (wife and 17-month old daughter Yamit) have moved back home to N.Y.C. (Forest Hills Queens, to be precise). Bernie is now doing transportation planning using CAD systems for the URS Company.

For me, well, things are quiet right now. Why don't you liven up my day sometime soon and send me a letter or a boring postcard? Please!—**David Browne**, Secretary, 50 Follen St., #104, Cambridge, MA 02138, (617) 491-5313 (home); (617) 956-2214 (work)

79

I'm delighted to say that, after months of listening to me nag, many of you have finally come through and allowed me to revive this column, which was about to die from starvation.

Lots of news this month from my old R/O week buddy, **Marla Eglowstein**, who writes, "The old news is that I missed the invasion of Grenada by about five months and transferred to New York University School of Medicine in the Fall of 1983. One of the first things that happened was discovering that I was waiting for the same Bellevue Hospital elevator as **Beth Marcus**, who had just returned from London after finishing her Ph.D. Neither of us knew that the other had come back, that we were working in the same place, or that we were both living in Stuyvesant Town. She has since relocated to Boston and is now with Arthur D. Little. A few months later, I moved to Brooklyn with Eliot Rich, whom I originally met in Elsie's Deli in Cambridge almost six years ago! He was about to begin his master's program at (dare I say it?) Harvard's Kennedy School of Government. By the time I returned from the Caribbean, he was working in New York, and we became reacquainted. We got married on June 9, and will be moving to Gold St., near the South St. Seaport. I just graduated from New York University, and will be doing my residency in obstetrics and gynecology at Beekman Downtown Hospital. We took a trip to Rome, Venice, and Paris in May, and had a marvelous time. It will be exciting to leave student life after all this time. I've almost forgotten what paychecks look like!"

Another old friend, **Michele (Gershman) Buchwald**, wrote to announce the birth of Carolyn ("Carly") Buchwald, born on May 30, 1985 (7 lbs. 12 oz., 19 1/2 inches). Carly's daddy—and the daddy of 4-year-old Benjamin and 2-year old Jackie—is Gary Buchwald, '76. Michele writes, "Up until Carly's birth, I was working at John Hancock as an actuarial associate. After a four-year hiatus, I had begun taking actuarial exams again. I've passed six exams and I am currently waiting for the results of my seventh. Gary is still working at Analog Devices in Norwood, Mass., and we still live in Sharon, Mass. All the 'all-nighters' we put in at M.I.T. have well prepared us for parenthood!"

Dan Jaffe came through with an update of the last several years: "After two years in Massachusetts as a high school teacher, I finally tired of the East Coast and applied to grad school in Washington. After a short stint at Western Washington

University, I'm currently in the chemistry department at University of Washington, pursuing a Ph.D. in atmospheric chemistry. My research involves Fourier Transform-IR studies of N gases of interest in the atmosphere. Of course, I'm still up in the mountains a great deal, and Washington is a great place for climbing (when it's not raining!). Since leaving M.I.T., I have managed some climbing trips to various parts of the world, including New Zealand, Europe, Yosemite, and Peru."

Bennett Baker is senior software Engineer for Lotus Development Corp. . . . **David Bernays** has been at Boeing for a year. He just bought a house in Steilacoom, Wash. with Cyndi Bedell, '81, and is "enjoying the damp Northwest!" . . . **John Featherly** is in private consulting and teaching at University of Alaska, Anchorage. . . . **Sow Chu** is working at General Electric Research and Development Center, on VLSI applications, analog circuits, and MOSFET modeling. . . . **Randall Fahey** is senior design engineer for Motorola, Inc., in the European Semiconductor Division in Geneva, Switzerland.

Janet Metsa writes, "Enjoying my job at EPA. Never thought I'd make a good bureaucrat! Celebrated our second anniversary with the birth of our first child, Galen Edward Mullins. My husband, Michael E. Mullins, and I are 1980 graduates of the School of Engineering Practice. We are, to the best of our knowledge, the first marriage of practice school alumni. That makes Galen the first offspring from the practice school!" . . . **Craig Albert** recently joined the New York law firm of Hertzog, Calamari, and Gleason. He writes, "Our practice includes civil litigation, corporate work for issuers and underwriters, banking, bankruptcy, private placements, public offerings, workouts, reorganizations, and some white collar criminal representation. I'm particularly interested in high-tech ventures, trade regulation, and litigation." . . . **Norm Guivens** is currently employed by SPARTA, Inc., in Lexington, Mass., working on "S.D.I. and other 'high-tech' projects."

Panayotis Cavoulacos joined the Washington, D.C., office of McKinsey and Co. in February. He was married to Alix de la Barre D'Erquennes last December 15 in Brussels. . . . **Paul Baltusis** says, "Hi folks! I am still at Ford Motor Co. designing electronic engine control software. I guess I never got cars out of my system. Very exciting work—if you mess up, there are 1,500,000 trucks out there to remind you!"

Charles Bright is a member of the technical staff at Hughes Aircraft Co. in Tucson, Ariz. He and wife Annie had a son, Charles Erik, on April 17. . . . The *Standard Times* of New Bedford, Mass. brings us the news that **Michael Gifford**, a mechanical engineer at Sippican Ocean Systems Inc. of Marion since 1979, has been named project engineer. Michael lives in Rochester with his wife, Sonny. . . . The Army and Air Force Home-town News Service was the source of this tidbit: "Air Force Captain **Mark Schwartz** has been chosen as company grade officer of the quarter for Seymour Johnson Air Force Base, N.C. Schwartz, a fighter pilot with the 334th Tactical Fighter Squadron, was selected in competition among contemporaries for professional skill, duty performance, and exemplary conduct."

This has been an exciting few weeks for your faithful secretary. Two Fridays ago, I had all four of my wisdom teeth out. Being the stalwart chap that I am, I had it done under a local anesthetic in the oral surgeon's office. Big mistake! Sage advice for those of you who still have this rite of passage to look forward to: have the surgeon hit you on the head with a mallet beforehand and wake you when it's all over! The unpleasantness of the operation itself notwithstanding, the recovery was quite an experience. My face swelled up so much that chipmunks started knocking at the door. The funniest part is that I was supposed to start a new job here at Mobil the following Monday. Instead, I missed a week of work and didn't start my new job until today. I'm still in telecommunications, but I have moved from planning to

operations. I am now the supervisor of Mobil's worldwide telephone network control center. I'll tell you what it all means when I figure it out myself! Added to all this fun was the possibility that we were moving next week, but that's fallen through. So we may get to enjoy the summer after all. Hope you all do, too.—**Sharon Lowenheim**, Secretary, 303 E. 83rd St., Apt. 24F, New York, NY 10028

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Happy Halloween, everyone! It feels funny to say that as I'm sitting here on a gorgeous Boston July Fourth—but it's a good way to remind you that news tends to be delayed about three months here in *Technology Review*. So, sorry if everything here sounds out-of-date.

This column is the first to be written since our class reunion in June so there's lots of news. First of all, if you haven't heard yet, our new class officers are: president: **Frank Wojtowicz**; vice-president/treasurer: **John Felleman**; secretary: **Kate Mulrone**; members-at-large: **Debbe Utiko**, **Kim Zaugg**, and **Joanne Tobias**. Please get in touch with any of us if there's anything we can do. Also—please get into the habit of sending news about yourself or any of our classmates to me (address below).

Let me start with the news I collected at the reunion. (Which, by the way, was quite well-attended and seemed to be a big hit—especially the whale watch cruise!) Thanks to everyone who contributed!

Susan (Rose) Pirkus is expecting a baby in November. . . . **Joan (Whitter) Miller** received her M.D. from Harvard University in June 1985. She will be an ophthalmologist. . . . **Adra (Smith) Acton**, after receiving her Ph.D. in materials science, will move to Arizona or New Mexico to work for Sandia Labs. . . . **Wes Asbury** recently married Sarah Francis in Knoxville, Tenn. (in May 1985); he still works for Oak Ridge National Labs.

Paul Rothman graduated from Yale Medical School last year and is now an intern at Columbia-Presbyterian Hospital. . . . **Dave Frank** and **Ron Weighel** are still M.D./Ph.D. students at Yale Medical School. . . . **Janet Young** received her M.D. this May from Yale and will be starting a radiology residency at the University of Michigan. . . . **Bill Cimino** is now doing his residency in orthopedic surgery at the University of California at San Francisco. . . . **Sheila Konecke Lease** is still working for IBM in Manassas, Va. . . . **Donna Kilian** moved from Los Angeles to San Francisco last year and is working "in the computer field." . . . **Randy Holl** got out of the navy in 1984 and is working for Syscon in Connecticut.

Marty Plys is living in Chicago and says he is enjoying the Blues and Grant Park concerts. . . . **Bryan Bentz** works for Bolt, Beranek, and Newman in artificial intelligence and lives in Back Bay. . . . **Arthur Hu** wrote, "I am in the R&D department at Musaic Software (not Technologies) (and loving it) working on IBM PC software and a 1-2-3 clone. No, I'm not in California! I play in the Newton Symphony, and am trying to figure out how to get back into the editorial business. After getting out, I did work for DEC, Data General, and myself from 1981 to 1983."

From **Carey Rappaport**: "I'm trying to figure out which class I'm in. Maybe after the Class of '82 reunion, I'll decide once and for all. I'm hoping to finish my M.I.T. education in a year or so—only ten or 11 years worth. Meanwhile, I'm beginning a fifth year as a graduate resident at East Campus. A pleasant surprise this year was winning the Compton Award. I guess if you stay at M.I.T. long enough. . . ." . . . **Hong Nguyen-Phuong** and **Teri Vo** (Harvard '83) are spending a year together in the Upper East Side of Manhattan where they see a lot of Nicholas Kojey ('81) who works in advertising and lives in the same building. Hong is taking a few years off from Harvard Business School, trying to start a few

companies, and "nourishing an undying entrepreneurial spirit."

Donna Bielinski works at a lab at Harvard Medical School. . . . **Manual Gutierrez** keeps busy these days by working at General Electric in King of Prussia, Penn., and by working toward a master's in systems engineering at the University of Pennsylvania. He bought a condominium in West Chester, Penn. . . . **Eric Balles** will be marrying Kathryn Geary, '85, on Pearl Harbor Day (December 7) this year. He says he's also "sweating out" what is hopefully his last year of a doctorate from M.I.T.'s Sloan Laboratory. . . . **David Plotnick** is still working at the Group Health Association of America in Washington, D.C., and living in Arlington, Va. He's been very successful at GHAA, where he's now director of research.

. . . **Theresa Ravese** is a Northwestern School of Management graduate and works for Pepsi.

Some other news sent to me by the Alumni Association: **Charles Yie** graduated from Sloan in June 1985 and should by now be working for Paine Webber Venture Capital Co. in Boston. . . . **Steve Frann** has changed jobs and careers: he's now a programmer with Applications Systems Corp. in Boston. . . . **Matt Steele** writes: "As a result of the Getty/Texaco merger, I have been relocated to Texaco's corporate headquarters in Harrison, N.Y. I am a senior analyst in the U.S. banking division, part of the finance department. I have bought a lovely condominium in Danbury, Conn. It's great to be back East once again!"

Timothy Ramsey writes that his activities are "swim team, water polo team, juggling club, and M.I.T. Seekers." This sounds like activities at M.I.T.—what are you doing now, Tim? . . . **Namir Kassim** just ended a two-year stay at the Clark Lake Radio Observatory located near Borrego Springs, Calif. He'll now be returning to the University of Maryland to write his Ph.D. thesis "whose bulk consists of the results of the newly completed 30.9 MHz Clark Lake survey of the galactic plane." (Sounds like astrophysics to me.) He says he's looking forward to returning to the East Coast but has grown attached to the desert of the Southwest and will miss the California sunshine.

Some newsworthy items: **R. Sheldon Carpenter** was awarded the General Electric Aircraft Engine Business Group's Ed Woll Young Engineer Award. He was honored for innovations on GE's F404 engine. Sheldon works for GE in Lynn. . . .

Keith A. Thompson was named an associate at Thompson/Crenshaw Airport Planning and Management Consultants in the Los Angeles office. He received his MBA from UCLA in June. . . . Drawing on my personal "files": **Marlon Weiss** married Cindi Pittlor on June 16, 1985 in Lincoln, Neb. Marlon just finished medical school at the University of Nebraska. He and Cindi are now in Indianapolis where Marlon has a family practice residency at the University of Indiana. Jerry Marks, '79, and Dave Plotnick were in the wedding party.

Tabetha Frey McCartney was at all the reunion activities with her husband Lee. She brought their adorable daughter to brunch. Tab is working in real estate (mortgage banking) in Boston while Lee is in business school. They are also doing some real estate tycoonage on their own! Tab graduated from Wharton (MBA) in June 1984.

Several of our classmates were also classmates of mine at Harvard Business School '84. **Frank Wojtowicz**, **Debbe Utiko**, and **Steve Mickel** were all at the reunion. Frank is materials manager for Data Instruments, Inc., in Lexington, Mass. He and his wife, Sharon, own a house in Natick near the Fluties! Debbe is a consultant at Strategic Analysis, Inc., in Reading, Penn., helping specialty chemicals manufacturers. Steve is a product manager at Becton, Dickinson and Co. in Rutherford, N.J. . . . **Susan (Nehyba) Garay** was also at HBS (but not the reunion) and is a manufacturing business analysis at Wang Labs in Lowell. . . . I am now a consultant at Arthur D. Little, Inc., in Burlington, Mass. I'm in a group that specializes in marketing and business planning for vendors

of information systems and related products.

John Fellman and **Marta Gross** participated in the reunion planning. Both live in the Boston area and, besides working days, are pursuing graduate degrees at night: John in business at Boston College, and Marta in law.

I hope I didn't miss anyone. I know I talked to many more people at the reunion, but. . . . Anyway—if I missed you (or even if I didn't) drop me a line. Let's try to keep all of our class notes this long!—**Kate Mulrone**, Secretary, 10 Arizona Terrace, No. 3, Arlington, MA 02174; (617) 641-3085 (Home); (617) 864-5770 (Work)

83

Hello again, fellow class members. I am currently sitting here with my jaws still aching from the four wisdom teeth extraction performed two days ago.

Douglas Brennan writes to us that he graduated from the satellite operations officers' course at Lowry Air Force Base in Colorado. You are probably asking yourselves the same question I am right now. Does Doug go to work for AT&T, Sprint, or MCI? We are all wrong. Doug opted for that very lucrative career in the Satellite Control Facility of the U.S. Air Force located in Sunnyvale, Calif. Sounds like you are on your way, Doug. Keep up the good work!

Sally Griffenberg wrote some romantic prose highlighting certain aspirations and secret desires she has had throughout her many years at M.I.T. She has always been intrigued with cash registers. Often times, she says, she would find herself getting very emotional over the sound of amounts being entered into the machine. Because of this excitement, Sally chose to work for NCR in South Carolina. She soon got bored with registers. "I do not know what made me so attracted to them in the first place. I think it was the thrill of the hunt." She is now hopeful of moving out to San Diego, maybe with TRW. Sally was kind enough to pass on some gossip on other class members.

Date: April 21, 1985. Place: Ridgewood, N.J. Attendees: Bakerites. Subject: Wedding of **Valerie Lemay** and **Richard Teal**. **Wes Bush** served as best man for the Ridgewood extravaganza, while Sally took over as special assistant to the maid of honor. **Sue Berg** and **Ann Beardsley** were also maid supplements. **Ann Beardsley** tried to go unnoticed but was soon discovered as having secretly eloped with **Tim Kuo** last May. **Cady Coleman** also attended. She proclaimed to be looking for a real man somewhere in the Boston area.

Sally also tells us that the male population can rest easy now. It seems that **Kim Elcess** has finally met her man. Kim was amazed to find someone with the same . . . zest for living? **Kimmy Lennhoff** has not been very active. She attended the wedding also. Kimmy argued throughout the entire ceremony with **Ruy Cardoso** about shaving his face. **Joe Daley** was mentioned, but nothing was said. **Peggy Pescatore** exhibited superb bounding abilities when she took the women's singles in the bouquet snatching competition. Peggy doesn't expect to follow through with her wedding plans since her bo, **Dave Shumway** is hiding somewhere in the Pacific in a submarine. Come on Dave, you can be more creative than that. Thanks for all of the great gossip, Sally.

Our Celebrity '83 for this issue goes to **John Piotti** for being a really good sport. John was nominated to be on the corporation. In the past election John lost the position to **Karen Fulbright**, '79. John has worked many hours with M.I.T. fraternities and the IFC and would have been a great corporation member. Congratulations for making it to the balloting stage, John. It is an honor in itself to be so highly regarded on campus.

Since my mouth is still sore, my dentist provides me the great challenge of not speaking. I

was supposed to leave for Atlanta last night but had to cancel my class. Believe it or not, I am still at home and have made no progress at all obtaining a more permanent place of residence. However, it is only July. Keep the letters coming, and enjoy Halloween.—**John E. De Rubeis**, Secretary, 47 Gillette Ave., Sayville, NY 11782

85

I hope everyone had a great summer and you've all headed back to school or have moved on to Yuppie-dom. Speaking of which, **Larry Shapiro** and **Adrian Wang** are the best examples of Yuppies I know. Larry is either traveling all over the U.S. on business or back in Boston cruising around in his new Prelude. And, if anyone is in San Jose let Adrian know; he has a spare room in his new townhouse complete with a pool and tennis courts. . . . On the other hand, many classmates have elected to pursue further studies.

. . . **Scott Chase** is continuing at Berkeley, **Daniel Morgan** at the University of Texas, Austin, and **Dan Weidman** at University of Maryland, all in physics. . . . I've heard through the grapevine that **Deb Meinholz** is in Louisiana but don't know what she is doing there—does anyone know? . . . Also, **Ken Conrad** was seen by a reliable source at the Blue Angels air show at Moffett field near San Francisco.

Jon Gafni is in San Francisco too, attending law school at Hastings. There is a slew of classmates working at H.P. in Cupertino and Palo Alto—**Joe Cernada**, **Andy Berlin**, and **Richard Lai** to mention a few. In fact, there are so many M.I.T. grads in Si-valley that if you yell "LSC . . ." in a movie theatre you're sure to receive at least one "sucks!" in response!

An amazing number of next house grads live in Cupertino. **Pat Jennings** is finishing his VI-A work and rooms with **Charly Market** and **Jon Rochlis**, who both worked at the Lawrence Livermore lab over the summer. I was fortunate enough to witness Pat Jennings' annual exhibition of his belly dancing skills at a popular restaurant in San Jose, an event not to be missed if you're in the area!

Contrary to popular belief, **Inge Gedo** is not currently attending med school; she is in Germany studying electronics intelligence presumably for the air force. Perhaps Inge can meet up with **Max Hailperin** for ein bier. Max received the Fulbright award and is continuing his studies—congrats!

Closer to home, Pat J. tells me that **Greg Wright** is working in Philly. Incidentally, **Chiquita White's** American Express bill was inadvertently sent to **Jeff Winner**, however he refused to pay it—nice try, Chiquita!

On a more serious note, **Mark Staples** is presumably married by the time this is published. . . . **Karla Stickley** and **Tim Bezanson**, '84, have also most likely tied the knot and are living in the midwest—Ohio to be exact. . . . **Wilhelmina Park** and **Peter Fader**, '83, will be married soon, as will **Robin Barker** and **Tim Chambers**, '84. . . . **Ray McDowell** is engaged to **Sharon Yhle**, '84, and is living with **Jeff Winner** and me while we finish our VI-A assignments with Fairchild.

Last I heard **Jim Hutchinson** and **Nancy DeFeo**, '84, were still dating while he finishes his VI-A with DEC. . . . **Gaile Gordon** is also at DEC finishing her VI-A work. Likewise, more of the Baker House grads, **Joe Kendall** and **Marion Evans** were still seeing each other, as are **Joyce Chung** and **Leo Casey**. And, I've been seeing **Oliver Patterson** when I'm in the Chicago or he's in San Fran on "business."

Still more Baker House news. . . . **Helene Sperling** is right at home in New York City working for Equitable Insurance, while **Virginia Change** is nearby in New Jersey making drugs for a reputable company. . . . Drop me a line regarding yourself, friends, or any others you would like to read about!—**Stephanie Scheidler**, Secretary, 4792 Raspberry Pl., San Jose, CA 95129

Nominations and Votes Place Alumni in New Posts



E.V. Wade



W. Hosley

Spring and summer sees alumni from across the nation stepping into new slots in the Alumni Association (AA) volunteer structure.

Working with the new president of the AA, E. Milton Bevington, '49, will be vice-president Emily Vanderbilt Wade, '45. Wade has been a member of the M.I.T. Corporation since 1979 and currently serves on its Executive Committee. She's also been on the M.I.T. Sea Grant State Industry Council since 1972.

There are five new members of the AA Board of Directors: William Hosley, '48, Dist. 3; Vito A. Caravito, '62, Dist. 6; Vigen Ter-Minassian, '64, Dist. 7; Bill C. Booziotis, M.Arch.'60, Dist. 8; and Robert Muh, '59, Dist. 9.



V.A. Caravito



V. Ter-Minassian

Hosley, recipient of a Lobdell Award in 1983, has served the Alumni Club of Rochester in just about every capacity. He chaired the Technology/Rochester Symposium in 1982, is the chairman of the Enterprise Forum for the city, and has been active in Alumni Fund work

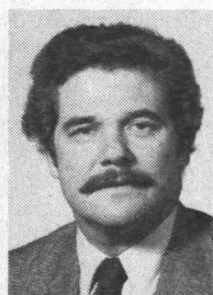
for some 15 years.

Caravito, also a Lobdell recipient, is a director of the M.I.T. Club of Cleveland and a member of the Educational Council. His work for the Alumni Fund included many years as regional gift chairman.

Another Lobdell Award recipient is Ter-Minassian, long-time activist in the M.I.T. Club of Washington, D.C., where he served as president and chairman of the Seminar Series. He was a board member for the capital city Enterprise Forum during its formative years and chaired the 1985 Washington telethon.



B.C. Booziotis



R. Muh

A Dallas native, Booziotis is a member of the Alumni Fund Board and the Visiting Committee for the School of Architecture and Planning. He received a Lobdell Award in 1981.

San Francisco resident Muh has been a member of the Committee on Nominations for the Corporation Visiting Committees, member of the Corporation Development Committee, 25th reunion gift chairman and president of the Class of '59, and a member of the Educational Council.

And in balloting for the National Selection Committee (the ballot that came wrapped around your April, '85 *Technology Review*), the winners were: Harl P. Aldrich, Jr., '47, Dist. 1; Joseph E. Dietzgen, '41, Dist. 2; and Ronald E. Enstrom, '57, Dist. 4. They were elected for three-year terms on the National Selection Committee, which chooses national officers of the AA and nominates



H.P. Aldrich



J.E. Dietzgen

alumni members of the Corporation.

Aldrich has been president of the Alumni Association and is a Life Member of the Alumni Council. He holds a seat on the Corporation, where he has served on the Executive Committee. Aldrich chaired the Visiting Committee in Civil Engineering and the Class of '47 40th Reunion Gift Committee, and received a Bronze Beaver in 1976.

Former president of both the M.I.T. Clubs of Cape Cod and Chicago, Dietzgen has put in years of service on the Corporation Visiting Committee for the Arts and the Institute Advisory Council for the Arts. He also worked on several fund raising programs.

Enstrom was involved in founding the



R.E. Enstrom

M.I.T. Clubs of Switzerland and Princeton, and served as president of the latter. He is a director of the New York Alumni Center and vice-chairman of the Princeton-Trenton Area Educational Council. For several years he was chairman of the Princeton area Alumni Fund. □

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Mechanical Engineering at M.I.T.: Are We Maintaining Our Edge?

TO THE EDITOR:

After jumping through the hoops for my S.B. and S.M. degrees in mechanical engineering, I've had three years in the real world to show me that M.I.T.'s educational process did an excellent job in preparing me for the demands of industry.

But I'm concerned that it may not do so for future students. While still a graduate student, I began to notice signs of the department I respected declining toward mediocrity. We stood in lines waiting to use World-War-II-vintage millers and lathes, of which the better ones may have been accurate to 0.01 inch. The idea of checking out an oscilloscope from the one equipment crib owned by the department was unheard of; we were lucky to get a digital voltmeter. Student-to-teacher ratios were 9 to 1 as opposed to the Institute average of 5 to 1.

Financial security was a potential problem for all graduate students except those supported by foreign governments. In several cases, graduate students' funding disappeared due to circumstances beyond their control, and there was no security net to catch them. As a result, some had to settle for engineering degrees in contrast to Ph.D.s, while others were forced to compromise course work so their theses could be finished earlier than planned.

Early this year I was asked to be a reference for an associate professor being reviewed for tenure nomination. I agreed, being enthusiastic about this teacher's contributions to my education. My concern for the department's welfare was aroused when I later learned that the decision was to recommend against tenure. The concern lies not only with the individual not being nominated—I believe his departure will be a true loss to the department—but with the fact that neither I nor any other of the alumni on that reference list was contacted. I would argue that alumni are as qualified, if not more so, than professors to assess the abilities of a professorial candidate who is going to shape future engineers.

If M.I.T. wants continued alumni support, it must remember that the Institute's reputation of having the most prestigious mechanical engineering department in the U.S. is a result of both its professors and the engineers it produces. I am truly worried about the future of the department at M.I.T., and I hope that publication of this letter will stimulate other alumni to join me in urging the improvements that I believe are needed.

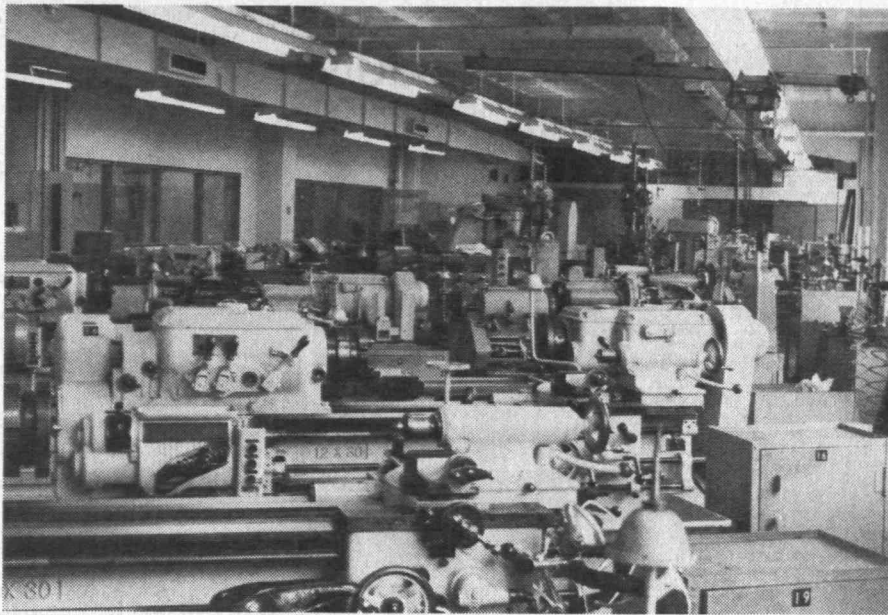
David M. Kane, '82
Reading, Mass.

The author is a systems engineer at Itek Corp., Lexington, Mass.

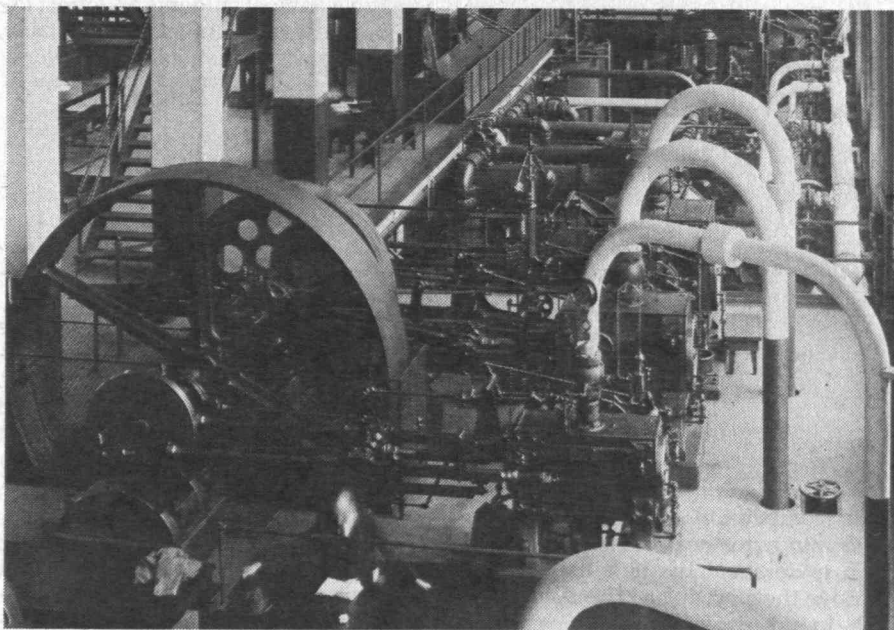
Professor David N. Wormley, '62, head of the Department of Mechanical Engineering, responds:

During the period when David Kane was an undergraduate and graduate student, the Department of Mechanical Engineering experienced an approximate doubling of enrollment in both its undergraduate and graduate programs. The department now has the second largest undergraduate enrollment at M.I.T. As a result, critical needs developed for increases in teaching staff and improvements in facilities.

In the last three years, the department has focused significant attention on undergraduate laboratories and facilities. In cooperation with Project Athena, it has introduced new computational equipment into the undergraduate measurement and instrumentation laboratories and into the project laboratory. In addition, this summer these laboratories have been refurbished to provide facilities appropriate for the increased number of students. In the manufacturing laboratory, a new numerically controlled lathe and other instrumentation and equipment have been added. Furthermore, this past year the department dedicated the new Martin Center for Engineering Design, a major project in which the fourth floor of Building 3 has been renovated to provide a prototype development laboratory, an interactive classroom, and special seminar rooms



In the first quarter of the century, when the steam and hydraulic lab (bottom left) was opened, no less than today, when "manufacturing processes and systems" (2.86) is taught in the machine shop in Building 35 (top), the program in mechanical engineering has relied on well-equipped facilities.



ure process involves an evaluation of a faculty member's contributions and accomplishments to the profession through scholarly research and service and to the academic program of the department through classroom teaching, curriculum development, and student advising. A candidate is asked to submit a list of potential references who may be asked to aid in the evaluation process. To protect both the candidate and the individual involved, some references are selected from the candidate's list and are augmented by other individuals who are also knowledgeable in the candidate's field. A primary purpose in seeking outside recommendations is to evaluate the candidate's standing and stature in his/her professional field as viewed by senior academic and industrial contributors to the field. Letters from graduates who have recently studied under a candidate have not normally been sought.

An important portion of the evaluation of the candidate concerns contributions to the academic program. Each semester, the student honorary society, Pi Tau Sigma, conducts an evaluation of all departmental subjects. These evaluations are reviewed by the department head and results are made available to tenure review committees. In addition, faculty within the department who have taught closely with an individual are asked for evaluations of the individual's contributions to the teaching program, curriculum development, and the development and advising of students.

In summary, the tenure evaluation is a process that is treated with considerable care. In cases in which tenure is not awarded, it is understandable that strong disappointment may occur among a faculty member's former students.

The continued excellence of the department is a primary concern of the faculty, who are making serious efforts to address the issues of educational quality that have been raised. Much further effort needs to be devoted to these areas, and we welcome the assistance of alumni in this continuing effort. □

for the teaching of small design sections.

Since 1976, the number of faculty in mechanical engineering has increased by approximately 20 percent to a total of 60 faculty, and the number of teaching assistants has increased by 25 percent to help meet the demand for teaching services. The undergraduate student-to-faculty ratio is now about 7.5:1.

Financial support for graduate students has been a concern of the department for many years. Most of our graduate students are provided support through research and teaching assistantships. Since 1980, the research assistantships available for the support of graduate students have increased from

165 to 199 and the number of U.S. students in our Ph.D. programs has grown from 60 to 100. In a number of cases, faculty have organized industrial consortiums to provide more flexible and longer-term funding for doctoral students and have also raised longer-term fellowship funds. While we have been encouraged by the industrial response to these efforts, these funds are still inadequate for Ph.D. student support, and support for fundamental Ph.D.-level research will remain a primary priority of the department.

The long-term health of the department depends upon the appointments of faculty to tenured positions. The ten-

IBM and Digital Invest \$50M in the Evolution of Campus Computing

A popular sport on campus, particularly among students, is speculating about what motivates Digital Equipment Corp. and IBM to participate in Project Athena to the tune of \$50 million in hardware and system support.

If there is a single, over-simple answer, it is this: Athena is as much a learning experience for IBM and Digital as it is for M.I.T.—and indeed for all of U.S. higher education.

An Industrial Liason Program (ILP) workshop last spring gave the heads of the two largest industrial teams within Athena an opportunity to address that question, and their comments were amplified in recent interviews with the *Review*.

Edward E. Balkovich is a consulting engineer with Digital, the company's senior staff member at M.I.T. He sees the explosion in university/industrial collaborations on the educational uses of computers as a logical outgrowth of several recent developments. Both industry and the universities perceived that time-sharing was on the wane; the model of computation for the future would be networked "high-performance workstations." The universities, however, were faced with declining public support for educational innovations; they needed resources from another quarter if they were to have a role in developing the new technology and its applications.

As a result, there was a period of intense competition among universities to win industrial support for their distributed-network programs, matched by in-



*The industrial
grants to Athena are
like giving Faulkner a
typewriter.
The donor can't expect
rights to his
next book.*

tense competition among vendors to enter into agreements that would help them understand the new market and improve their products. The tax advantages to industry offered by such agreements only made them more attractive.

The "3-M Machine"

The high-performance workstation, as now conceived by all parties to Project Athena, is commonly referred to as a "3-M machine." The workstation will have a megapixel display, operate at one million instructions per second, and have a megabyte of storage. A megapixel display means that the screen is a matrix with a thousand dots on a side, providing very high resolution graphics. "If the new screens can display information—both text and illustrations—so that they can be read as comfortably as a book," says IBM's Richard Parmelee, Ph.D. '66,

"that will be a quantum leap—the next step in functionality."

M.I.T. plans to install more than 2,000 of the new machines. They will be capable of standing alone but will also be linked into local area networks that are then linked to a variety of servers, such as high quality printers and libraries. The plans in fact call for a workstation analogous to the present generation of minicomputers but designed to fit on a desktop and cheap enough to be widely accessible to most students and most institutions. Several universities, notably Carnegie Mellon, have adopted a workstation standard similar to M.I.T.'s.

"What Are You Trying to Do Now?"

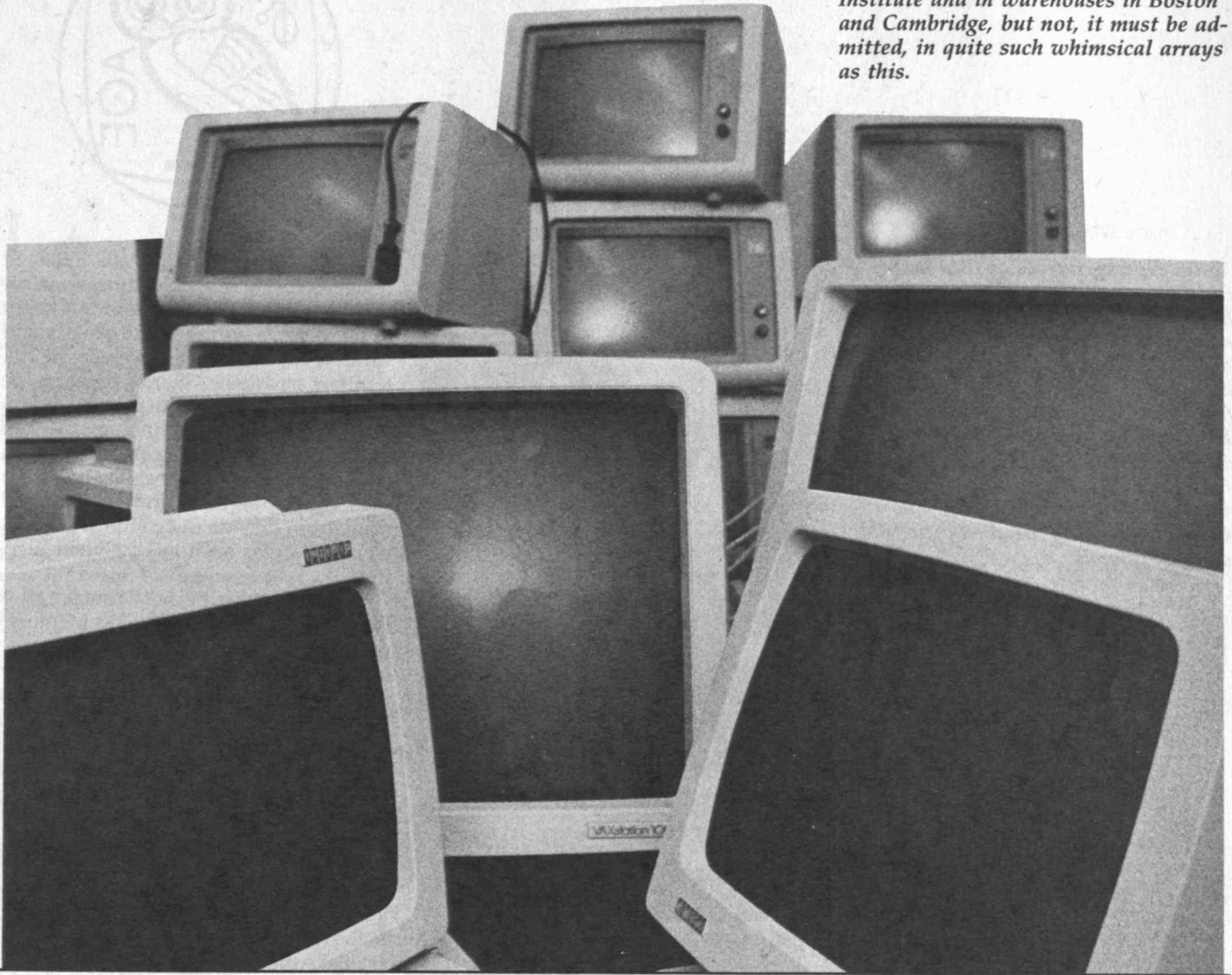
Digital was specifically interested in M.I.T.'s Athena for several reasons, Balkovich says. First of all, M.I.T. was offering to set up a large-scale laboratory to study the new model of computation. The Institute is geographically close to Digital's corporate headquarters and is strong in the areas where the company traditionally markets its products—science, technology, and education; that meant that the opportunities for cross-fertilization would be many, the corporation reasoned.

What's more, networked workstations would be a significant new product direction for Digital. A substantial involvement in Athena would demonstrate Digital's commitment to this technology, Balkovich says, and also its keen interest in engineering education.

In some ways, Balkovich believes, Athena has gone beyond the expectations the corporation had for the first few years of the project. Deployment of Digital machines is on schedule. Faculty and student involvement and the number of projects actually introduced into the classroom are substantial. And although the system does not yet have all the functions users might want, the computing environment is uniform across all the machines. Balkovich says that's a good first attack on the issue of coherence. But like everyone else, Balkovich had anticipated that with the re-

Editor's Note: This is the second in a four-part series on Project Athena, M.I.T.'s experiment in introducing networked student workstations into every aspect of the undergraduate curriculum. Subsequent articles will focus on the actual computer-use projects developed by faculty and on the impact of Athena on students, from student consultants and installers to the "student on the street" who uses the system for the first time. Editor Susan Lewis welcomes alumni questions on the project.

Athena hardware is accumulating in impressive quantities in corners of the Institute and in warehouses in Boston and Cambridge, but not, it must be admitted, in quite such whimsical arrays as this.



sources concentrated here, the project could move ahead faster. And like Professor Steven Lerman, '72, M.I.T.'s director for Athena (see *August/September*, p. A5), Balkovich says that the high level of faculty participation in the project created operational demands on the system that limited progress in other areas.

Balkovich also notes that, in general, managing expectations in a large university-industry collaboration is difficult. The Athena staff feels continual pressure to provide more computing power. He also notes the pressure to communicate results and short-term objectives to the Institute community. "Just what are you trying to do *right now*?" students and staff need to know.

Several of the issues in educational computing that Athena will have to address are of great interest not only to Digital but to nearly everyone in the academic and industrial communities, Bal-

kovich believes. High on the list are software licensing, protecting hardware from theft and tampering, and ensuring the privacy of system users. And in these new, widely accessible systems, it will be prohibitively expensive and totally impractical to call in a service engineer for every malfunction; so maintenance of the hardware will have to be on an entirely new footing.

Balkovich is pleased to report that the input from the M.I.T.-based Digital staff is valued by his company. Lessons learned on campus are taken into account when planning new products and future marketing strategies. Conversely, his staff has helped academics find help with their projects from within the company. He sees a long-term and growing role for the on-campus industrial engineer as a conduit of information in both directions.

Parmelee, the technical leader of the

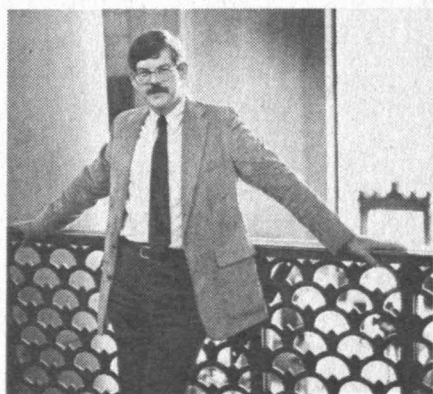
IBM unit, agrees. IBM has a three-year agreement with the Institute to help launch Athena, an effort that is projected to take five years. But Parmelee anticipates that campus-based industry engineers will be on the front lines of a 10-year nationwide transition from one computation technology to its successor: from timesharing on central machines to distributed networks of high-performance workstations. He notes that the transition from batch processing on mainframe computers to timesharing also took about ten years to evolve from its early, experimental use to application on virtually every American campus.

Education Requires Special Focus

IBM believes technology will evolve primarily in response to the needs of most commercial customers, Parmelee says, and that research needs can ride the



To the representatives of IBM and Digital Equipment Corp. stationed at M.I.T., they are but the vanguard of a number of industry-based engineers who will help universities and colleges across the country make the transition from a timesharing model of computing to networked high-performance workstations. Edward Balkovich (below) heads the Digital group, while Richard Parmelee, Ph.D. '66 (far right) and Charles Salisbury, '64, direct the IBM staff on campus.



coattails of those customers. But the company wants exposure to the educational requirements for technology as well. Input from Athena and almost 20 other IBM-supported advanced educational projects will help ensure that computing also evolves in ways that support classroom applications.

When Athena started, there was no model for how it would work, Parmelee says. No one has yet deployed 1,000 workstations or made computers ubiquitous on campus. "This experiment really turns on how education can be improved by making this equipment widely available," he says.

There is no proprietary software being developed at M.I.T., Parmelee notes. "Sometime during the negotiations, someone described (the IBM equipment grant) as very much like giving Faulkner a typewriter. You can't expect rights to the next book the man writes."



IBM not only subscribes to the technical objectives of Athena, but has a serious interest in many of the non-technical ones. For example, how will M.I.T. move towards student-owned equipment? "We're talking about 1,110 freshman coming in. Let me tell you, just to unpack 1,100 IBM PC/ATs would be a Herculean task," Parmelee says, but the students can't wait until the end of the first semester for their machines. Scaling up the mechanics of deployment will create mind-boggling problems.

Reordering the Campus

IBM is also aware that there are important issues in infrastructure—how will universities reorder their campuses? If each of M.I.T.'s 2,000-plus workstations needs 35 square feet of floor space, we're talking about acres of campus real estate. Then there is the question of wir-

ing: Stanford is digging six miles of trenches for its telecommunications cable, but a simple trench wouldn't begin to fill M.I.T.'s wiring requirements and wouldn't enable Athena to reach the fraternities across the Charles River.

All parties to Athena have to be on the lookout for new technology that can alter the computational climate in which students and faculty operate, Parmelee says. Many of these innovations will come from outside the computer industry, from areas such as consumer electronics.

To illustrate his point, Parmelee cites the compact ROM (read only memory) disc players that will allow for storage of 500 million bytes of data on a tiny glass disc. In theory, when mounted on a personal computer, this disc would make very large quantities of data available very close to processing power. The players will cost in the neighborhood of \$200, Parmelee says, and the glass discs will probably be manufactured in the billions and cost next to nothing. This technology will be introduced and mature in a matter of months, in sharp contrast to the long lead times required for a project like Athena. It could alter faculty and student perceptions of personal computers in ways we cannot predict.

Managing Project Athena is not getting any less complex as it goes into its third year. One indicator is the fact that the responsibility for running the IBM effort has been divided in two, so that it more closely resembles M.I.T.'s Athena management. Parmelee, formerly the project leader, is now IBM's technical leader for Athena, while Charles Salisbury, '64, is the project manager.

It can be difficult to coordinate the efforts and learning curve for the three main players—M.I.T., Digital, and IBM—to say nothing of working with the other industrial partners, Codex and Bolt, Beranek and Newman. Ed Balkovich is convinced that the planners of Athena made many right choices. He notes particularly that the nonproprietary nature of the innovations here make for an exceptional level of cooperation in problem-solving.—Susan Lewis □

NEWS FROM THE DEPARTMENTS

I CIVIL ENGINEERING

Two members of the faculty at M.I.T. have been promoted to the rank of associate professor: **Victor Li**, who came to the Institute in 1981 after studies at Brown University to specialize in the mechanics of solids and structures; and **S. Shyam Sunder**, Sc.D.'81, whose work is in the field of structural engineering applied to offshore petroleum resources.

Peter Ostrowski, Jr., '81, writes from Norris, Tenn., where he works at the TVA Engineering Laboratory, "Spring is the time for babies and we have a 1985 model. Jill Hurst Ostrowski was born April 15, which means she will probably be working for the IRS." . . . **David E. Wheeler**, S.M.'61, has been named manager of Wagner-Hohns-Inglis, Inc., Tampa, Fla., international consultants to the construction industry. Wheeler joined the firm several years ago after 30 years with the U.S. Corps of Engineers and as associate professor of civil engineering at the U.S. Military Academy.



D. E. Wheeler

Jerome B. York, S.M.'61, has been elected vice-president for advanced manufacturing operations at the Chrysler Corp., responsible for advanced manufacturing planning, current manufacturing planning and engineering activities. York returned to Detroit to take his new job from a post as managing director of Chrysler de Mexico S.A. . . . **Boris W. Boguslavsky**, Sc.D.'38, was keynote speaker at the banquet of the 1985 Institute of Industrial Engineers Region VII Conference at Louisiana State University, Baton Rouge, last March 1. . . . President Reagan's nomination of **S. Bruce Smart, Jr.**, S.M.'47, to be undersecretary of commerce for international trade was confirmed by Congress early in August. Smart had been with the Continental Group, Stamford, Conn., since 1953, in various sales and general management positions, rising to become president (1975-80) and chairman and C.E.O. . . . **James E. Ashton**, Ph.D.'65, resigned in July 1984 as president and chief operating officer at Healthdyne, Inc., Marietta, Ga.

Three deaths have been reported to the Alumni Association, with no further information available: **Charles G. Etter, Jr.**, Sc.D.'53, of Wayne, Penn., on December 22, 1983; **Wesley R. Floyd**, '42, of Bradenton, Fla., on February 29, 1984; and **Lawrence Tsuan-Ying Kwan**, S.M.'53, of Encino, Calif., in December 1967.

II MECHANICAL ENGINEERING

Four members of the faculty at M.I.T. have been promoted to the rank of associate professor: **Triantaphyllos R. Akylas**, Ph.D.'81, whose recent research has been on the generation and evolution of water surface waves by wind; **Haruhiko Asada**, who joined the faculty in 1983 after graduate studies at Kyoto University, Japan, on robotics, measurement, and instrumentation; **Wai K. Cheng**, Ph.D.'70, a specialist in diesel engine combustion; and **Anthony T. Patera**, '78, noted for contributions in computational fluid mechanics. . . . Professor **Richard H. Lyon**, Ph.D.'55, of M.I.T. was elected a fellow of the American Association for the Advancement of Science late last spring.

John W. Carson, Ph.D.'71, has been promoted from senior vice-president to president of Jenike & Johanson, Inc., North Billerica, Mass. . . . **Pangal Ranganath Nayak**, Sc.D.'68, manager of the Mechanical Manufacturing and Transportation Technology Section of Arthur D. Little, Inc., Cambridge, Mass., has been elected vice-president of the firm. He's directing an ongoing ADL study of small transit bus use. . . . **Michael D. Johnson**, S.M.'81, has completed an initial tour of duty on the USS *Mariane G. Vallez* SSBN658(B) and has now been assigned to the U.S. Naval Academy to be an instructor in the Engineering Department. . . . **Rosendo Fuquen**, Sc.D.'82, senior research metallurgist at Timken Research, Canton, Ohio, has been promoted to section leader of steel product research.



R. Fuquen

Professor **John B. Heywood**, Ph.D.'62, director of the Sloan Automotive Laboratory at M.I.T. has been named ASME's 1986 Freeman Scholar; he'll lecture at the winter meeting a year from now on fluid motion in internal combustion engines, reporting his research activities on the operating and emissions characteristics and fuel requirements of automotive and aircraft engines. . . . **Richard T. Roca**, Sc.D.'72, director of the AT&T Bell Laboratories, Holmdel, N.J., has been named a fellow of ASME for his significant contributions in telecommunications. . . . **Shao T. Hsu**, S.M.'43, of Bethesda, Md., passed away in 1985; no further details are available.

III MATERIALS SCIENCE AND ENGINEERING

M.I.T. has been designated the lead institution in a new industry-university consortium for the development of composite materials, and some \$15 million will be provided by the Strategic Defense Initiative Office during the next three years for work on the processing and evaluation of metal and ceramic matrix composites. M.I.T. itself will use some \$6.5 million for studies of the processing and properties of composites. The goal, says **James Cornie**, director of the new program: "the complete and fundamental understanding of the relationship between processing technique and mechanical, thermal, and physical properties of composite materials."

Professors **Terry A. Ring** and **Gary E. Wnek** have been promoted to the rank of associate professor in the department at M.I.T. Ring, who studied at Clarkson College, the University of California at Berkeley, and Cambridge University, specializes in particulate processing, while Wnek, whose degrees are from Worcester Polytechnic and the University of Massachusetts, is recognized for pioneering work in conducting polymers. . . . Professor Emeritus **Michael B. Bever**, Sc.D.'42, senior lecturer in the department at M.I.T., is the editor-in-chief of the eight-volume, 5,000-page *Encyclopedia of Materials Science and Engineering* published late last spring by the M.I.T. Press in association with Pergamon (\$1,500 before March 31, 1986; \$1,950 thereafter). Professor **Walter S. Owen** of M.I.T. was chairman of the encyclopedia's International Editorial Advisory Board, and among subject editors were **Gilbert Y. Chin**, '59, head of physical metallurgy and ceramics at AT&T Bell Laboratories (magnetic materials); **Philip C. Clapp**, Ph.D.'63, professor of metallurgy at the University of Connecticut (special topics in materials science); **Thomas B. King**, professor of metallurgy at M.I.T. (metals production); **Robert A. Laudise**, Ph.D.'56, director of physical and chemical research at AT&T Bell Laboratories (electronic materials); Professor **Margaret L. A. MacVicar**, '65, dean for undergraduate education at M.I.T. (superconducting materials); **Koichi Masubuchi**, professor of materials science at M.I.T. (welding); **Fred Moavenzadeh**, professor of civil engineering at M.I.T. (building materials); **Gilbert R. Speich**, Sc.D.'58, professor of metallurgical and materials engineering at Illinois Institute of Technology (applied ferrous physical metallurgy); and **Jack H. Westbrook**, Sc.D.'49, of the General Electric R&D Center (electrical materials). . . . Professor **John F. Elliott**, Sc.D.'49, of M.I.T. was elected a fellow of the American Association for the Advancement of Science late last spring.

Energy-efficient preparation, fabrication, and use of materials is the subject of a new interdisciplinary research thrust at M.I.T. and the Idaho National Engineering Laboratory under sponsorship of the DOE's Office of Energy Research. Four research areas are involved—plasma processing, automated arc welding, mechanics of solids, and engineering analysis and design—and the first three-year phase of the work is expected to cost about \$5 million. Professor **Kent H. Hansen**, '53, of the Department of Nuclear Engineer-

ing is in charge of the M.I.T. participation as associate director of the Energy Laboratory.

Milton Stern, Sc.D.'50, vice-chairman of Stauffer Chemical Co., Westport, Conn., has been elected to the board of directors of Chesebrough-Pond, Inc., Greenwich, following Stauffer's acquisition by the Greenwich-based firm. . . . **William A. Griffith**, S.M.'50, president and chief executive officer of Helca Mining Co., Wallace, Idaho, is now also the company's chairman. . . . **F. William Bloecher**, S.M.'49, writes, "Marsh Gibbon Ltd., Wycoff, N.J., is my own consulting company, which I set up two and a half years ago on opting for early retirement from American Cyanamid Co. after 32 years of service."

Ramon S. Sevilla, Sr., S.M.'39, passed away on April 1, 1985 in Metro Manila, Philippines. In a note to the Alumni Association, **F. Leroy "Doc" Foster** '25, who taught mining engineering at M.I.T. before becoming assistant to the director of the Division of Industrial Cooperation in 1939, writes, "Ramon was one of my students and a good friend. After graduation from M.I.T. he went into mining in the Philippines for six months, then returned to Manila to assist his father in business. He survived World War II and did well after that . . . his seven children all received excellent educations in colleges in the U.S. and are doing well."

IV ARCHITECTURE

Lasar Treatment, a first book of poems by **Elizabeth Goldring**, exhibits and projects director at the Center for Advanced Visual Studies, has been published by Blue Giant Press, Boston. Writing in *New Letters* magazine, critic Dan Jaffe describes Goldring as an "emerging talent. . . . The best (of the poems) remind us what happens when writing is done ceremoniously, when the world is regarded with devotion."

Professor **Nicholas P. Negroponte**, B.Arch.'66, director of the Media Laboratory, is the first Jerome B. Wiesner Professor of Media Technology at M.I.T., a chair established in Wiesner's honor by Schlumberger Technology Corp. in 1980. Negroponte, a member of the faculty since 1968, was founding director of the Architecture Machine Group for 15 years before he was on leave in 1982 as the first executive director of the World Center for Personal Computation and Human Development in Paris. Negroponte is a specialist in human-computer interaction, a world authority on interactive computer graphics.

Navroz N. Dabu, S.M.'83, formerly of Ahmedabad, India, has joined Seppala & Aho Construction Co., New Ipswich, Mass., as a draftsman. Dabus worked as an architectural assistant for the Indian state government in design, cost analysis, site supervision, and graphic design as well as other interior design projects before returning to the U.S. . . . **Robert A. Mayers**, M.Arch.'62, is a principal with Mayers and Schiff Associates, New York City, architects/planners. The firm's current work includes an urban design project for Times Square, and the design of facilities for IBM and Columbia University. . . . **Josephine O. Adams**, M.Arch.'80, is principal architect at the Newark (N.J.) Housing Authority.

V CHEMISTRY

Professor **John M. Deutch**, '61, provost of M.I.T., is a member of a new panel to study the impact of national security controls on international technology transfer convened by the Committee on Science, Engineering, and Public Policy of the National Academies of Science and of Engineering and the Institute of Medicine. The panel, focusing on the transfer of militarily-sensitive technology through commercial channels and the possible effects of controls on U.S. industry, will report in the fall of 1986.

Professor **K. Barry Sharpless** of M.I.T. was

elected a fellow of the American Association for the Advancement of Science late last spring. . . . Professor **Stephen J. Lippard**, Ph.D.'65, in the department at M.I.T. received the Henry J. Albert Award of the International Precious Metals Institute on June 11, 1985, in New York City. The award—consisting of a palladium medal—was given "in recognition of his extensive contribution to the bioinorganic chemistry of precious metals and in particularly his achievements in metal-nucleic acid interactions." Lippard spent more than 16 years on the faculty at Columbia University before returning to Cambridge in January 1983, and his research activities span the fields of inorganic and biological chemistry.

Robert R. Luise, Ph.D.'70, senior research chemist at the du Pont Experimental Station, Wilmington, Del., has completed his third year of service as president of the M.I.T. Club of Delaware Valley. . . . **O. William Lever**, Ph.D.'74, has joined the Ortho Pharmaceutical Corp., Raritan, N.J., as group leader in medicinal chemistry. Lever has published more than 15 publications and review chapters in various areas of organic and medicinal chemistry and is a member of the American Chemical Society and Sigma Xi.

Gerald D. Laubach, Ph.D.'50, president of Pfizer, Inc., New York City, was presented a first annual New York Mayor's Award of Honor for Science and Technology last May 21 by Mayor Edward Koch. The award recognizes men and women living or working in the city who made major contributions in science and technology. Laubach was cited for "significant contributions to medicinal chemistry, drug discovery, and drug development." . . . **Robert N. Nelson**, Ph.D.'69, writes, "I spent the summers of 1984 and 1985 at NASA Goddard Space Flight Center, studying interstellar granules. I am associate professor of chemistry at Georgia Southern College."



An honorary membership in the Alumni Association recognizing "outstanding service" to alumni was presented at the Technology Day luncheon on June 7 by Mary Frances Wagley, '47, retiring president of the association, to John A. Tucker, director of the Course VI-A Internship Program. Tucker was cited for his interest and concern for alumni—as exemplified by his regular reports in Technology Review—through 29 years of service at M.I.T.

VI ELECTRICAL ENGINEERING AND COMPUTER SCIENCE

Four members of the faculty at M.I.T. have been promoted to the rank of associate professor: **Jeffrey H. Lang**, '75, an expert in controls for mechanical and electromechanical systems who worked at the Draper Laboratory while completing his doctorate (M.I.T.'80); **Terry P. Orlando**, a specialist in applied superconductivity whose doctorate is from Stanford ('81); **Richard E. Zippel**, '74, who has been working on VLSI systems design throughout his career at M.I.T. as an undergraduate and graduate student and assistant professor; and **Victor W. Zue**, Sc.D.'76, one of the world leaders in the field of speech recognition by computer.

Ninety oscilloscopes have come to the department at M.I.T. from Tektronix, Inc., Beaverton, Ore., of which **Howard Vollum**, a member of the EECS visiting committee, is cofounder. The new machines, valued at nearly \$400,000, will be used to replace obsolete equipment in the undergraduate teaching laboratories.

Barbara H. Liskov, a member of the department faculty at M.I.T. since 1972, is now NEC Professor of Software Science and Engineering, holding a chair funded by NEC Corp. of Tokyo in 1982. Liskov studied at the University of California at Berkeley and Stanford (Ph.D. 1968). She is a specialist in distributed computing; her current work is the development of a new programming language (called ARGUS) that will support the execution of robust distributed programs that survive hardware failures.

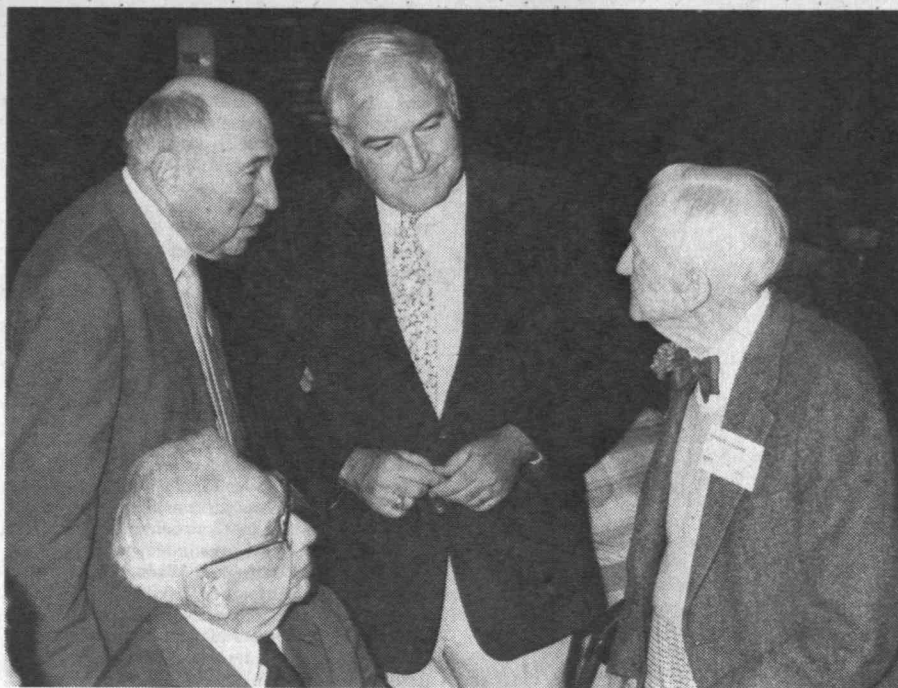
Assistant Professor **Robert C. Berwick**, Ph.D.'82, in the department at M.I.T. is the 1985 recipient of the Harold E. Edgerton Faculty Achievement Award. Berwick's work bridges several fields—linguistics and cognitive psychology as well as computer science and artificial intelligence. . . . "He has proven to be an extraordinarily productive and influential scholar whose impact is likely to grow in the near future," read the citation.

Kenneth A. Van Bree, S.M.'71, writes, "In January 1985 I was promoted to section leader of the Design Automation Section of the Design Technology Laboratory of Hewlett-Packard, Palo Alto, Calif." . . . **Harold C. Friend**, S.M.'53, writes that since 1961 he has been assistant professor of mathematics at University College, University of Maryland, on a part-time basis. In September 1984, Friend retired as electronics engineer for satellite communications from the Defense Communications Engineering Center, Reston, Va. . . . **Paul K. Houpt**, Ph.D.'75, who recently joined the General Electric Research and Development Center, Schenectady, N.Y., has been appointed manager of the Industrial and Aerospace Control Program. Prior to joining GE in 1984, Houpt was associate professor of mechanical engineering at M.I.T.

Donald J. Atwood, S.M.'48, executive vice-president of General Motors Corp., has been re-elected a councillor of the National Academy of Engineering. . . . **Alan W. Carlson**, Ph.D.'62, has been named president of M/A-COM Millimeter Products, Inc., Beverly, Mass. Carlson has been vice-president and general manager of M/A-COM's Automatic Test Equipment Group since 1982. . . . **Roy L. Morris**, S.M.'78, has been promoted to senior regulatory counsel at MCI Communications Corp., Washington, D.C., and has been admitted to the District of Columbia Bar and Patent Bar. . . . **Duane R. Barney**, S.M.'38, reports that he has retired after 41 years of service as an electrical engineer.

VI-A Internship Program

This is my first public opportunity to thank the Institute and its Alumni Association for the high honor bestowed on me at the Technology Day luncheon back on June 7. At that time I was presented a "diploma" as an honorary member of the M.I.T. Alumni Association, an honor given to



Harold S. Osborne, '08 (far right), honored as the oldest alumnus at the Technology Day luncheon last June 7. Osborne, M.I.T.'s first recipient of a doctorate in electrical engineering in

1910, is shown with Warren Glancy, '13 (seated), Carole A. "Cac" Clarke, '21 (far left), and President Paul Gray, '54. (Photo: Frank Revi, '86)

only 92 others since it was authorized by the By-laws in 1897. My citation read, in part, "for his many contributions through a mini-alumni association of his own comprised mainly of graduates of the VI-A Internship Program." My comment to Paul E. Gray, '54, afterwards, was "This now, makes me really feel a part of the Institute." I gratefully acknowledge this distinct honor.

Following the Technology Day luncheon Director Tucker met with **Harold S. Osborne, '08**, and his wife. Dr. Osborne was M.I.T.'s first recipient of a doctorate from the Electrical Engineering Department in 1910. The Eng.D. degree was discontinued in 1918 and Sc.D. degrees given instead. The Institute offered to exchange the Eng.D. for the Sc.D. for those already awarded. Of the six originally awarded, three decided not to exchange their Eng.D's, including Osborne, **Vannevar Bush, '16**, and **Roy D. Huxley, '11**. Dr. Osborne's career took him to the post of chief engineer of AT & T.

Another pleasant announcement is that the department's search to fill the new position of associate director, VI-A Internship Program, has been successfully completed. **Kevin J. O'Toole, N.E.'57**, Captain, U.S.N.(ret.), joined the VI-A staff in that position on August 1. Mr. O'Toole has been at M.I.T. since 1973, serving first on the faculty in the Ocean Engineering Department, later as technical officer in the Technology Adaptation Program in collaboration with Cairo University. Captain O'Toole received his B.S. degree from the U.S. Naval Academy before coming to M.I.T. for S.M. and Naval Engineer degrees. I hope that many of you will take the opportunity to become acquainted with him in the near future.

A formal contract signing ceremony, officially placing Bellcore (Bell Communications Research) in the VI-A Program, took place at their Livingston, N.J., corporate headquarters on July 19 in the office of **Irwin Dorros, '56**, executive vice-president for technical services. Representing M.I.T. were **Frederic R. Morgenthaler, '55**, Bell's

VI-A faculty adviser, and VI-A Director **John A. Tucker**. Two other alumni present were **Chester M. Day, Jr., '57** and **Victor L. Ransom, '48**, both of whom were formerly involved with VI-A at Bell Laboratories. Both Chet Day, Jr. and his father, **Chester M. Day, '28**, graduated from VI-A, his father having spent many years with the New England Telephone & Telegraph Co. Chet Jr.'s son, **Stephen M. Day, '87**, is currently a junior in Course VI.

Technology Day was, as usual, a pleasant opportunity to renew acquaintances. Breakfast was enjoyed with, amongst others, **John D. Chisholm, '75**, here for his ten-year class reunion, and **Sherman Karp, '60**, and his wife. **Sharam Shirazi, '77**, joined our luncheon gathering; Sharam's with Zilog, Inc., Campbell, Calif.

Others who've called or visited the VI-A Office include: **Jerome L. Abel, '58**, a consulting engineer; **Jeffrey D. Beck, '70**, with the Central Research Labs. of Texas Instruments, Dallas; **G. Richard Blake, '39**, from Pittsburgh, Penn.; **John F. Cooper, '74**, with Dolby Labs., San Francisco; **Edward C. Giaimo III, '74**, with Zetron, Inc., Bellevue, Wash.; and **George B. Yundt, '83**, with IMEC Corp., Boston.—**John A. Tucker**, Director, VI-A Internship Program, M.I.T., Rm. 38-473, Cambridge, MA 02139

VII BIOLOGY

Funding of \$750,000 annually for up to five years has come to the Center for Cancer Research from the Ajinomoto Co., Inc., a major Japanese food and pharmaceutical producer. The grant will support basic research in immunology and cell biology; Ajinomoto is noted for its success in the manufacture of amino-acid-based products.

Assistant Professors **Leonard P. Guarente, '74**, and **Monty Krieger** have been promoted to the rank of associate professor. Guarente, whose Ph.D. is from Harvard ('78), received a Presiden-

tial Young Investigator Award in 1984 on the basis of his work using genetic and molecular biological techniques to study gene regulation, and Krieger is continuing work begun as a graduate student at California Institute of Technology on the transport of cholesterol in humans.

Professors **Jonathan King** and **Paul R. Schimmel, Ph.D.'67**, of M.I.T. were elected fellows of the American Association for the Advancement of Science late last spring.

Milton B. Adesnik, Ph.D.'69, writes, "I am currently an associate professor of cell biology at New York University School of Medicine."

Margaret M. Blizard, S.M.'63, an attorney, who made major contributions to the management of public and mental health in Massachusetts, passed away on May 10, 1985. Blizard, an early organizer of the League of Women Voters, was a member of the American Public Health Association for 40 years (which honored her in 1984 for dedicated service). Blizard was administrative and legal assistant to the Massachusetts commissioner of public health from 1965 to 1983. In recognition of her many accomplishments, Blizard was named Woman of the Year by the Norwood (Mass.) Business and Professional Women's Clubs in 1964 and 1976, and she received the Woman of the Year Achievement Award of the State Federation of Business and Professional Women in 1977.

VIII PHYSICS

John W. Dreher, a specialist in radio astronomy whose degrees are from the University of California at Berkeley, has been promoted to the rank of associate professor in the department at M.I.T.

... Professor **Bruno Coppi** of M.I.T. was elected a fellow of the American Association for the Advancement of Sciences late last spring. ... A Guggenheim Fellowship for 1985 has been awarded to Professor **Min Chen** of M.I.T. to support his studies in experimental high-energy physics.

Gordon P. Garmire, Ph.D.'62, a faculty member at Pennsylvania State University, has been named an Evan Pugh Professor—the most prestigious award the University bestows on its faculty members. Garmire is a top high-energy astrophysicist and a leader in gamma-ray and X-ray detector development. ... **Cyril M. Harris, Ph.D.'50**, Charles Batchelor Professor of Electrical Engineering and professor of architecture at Columbia University, received a Mayor's Award of Honor for Science and Technology presented by New York City Mayor Edward I. Koch last May 21. The citation was for "masterful contribution to the technology of acoustics that has given a true and joyful voice to concert halls in our city and throughout the world."

Martin Annis, Ph.D.'44, president and founder of American Science and Engineering, Inc., Cambridge, has been named chairman of the North-Metro Private Industry Council (PIC). PIC oversees and sets policy for Employment Resources, Inc., a community-based job screening training and placement service made up of community business, government and academic leaders from 20 cities and towns northwest of Boston. ...

Lynn R. Cominsky, Ph.D.'81, a member of the Space Sciences Laboratory at the University of California at Berkeley, is the science operations and data analysis administrator on the Extreme Ultraviolet Explorer Satellite, which is due to be launched in late 1988.

Theodore R. Steger, Jr., Ph.D.'74, director of exploratory and fundamental research in the Polymer Products Division of the Monsanto Co., Springfield, Mass., died of cancer in March, 1985. Steger worked with Monsanto for 11 years in both St. Louis and Springfield locations. He studied at the University of Florida, where he was made a member of Phi Beta Kappa before coming to M.I.T. ... The deaths of two other alumni have been reported to the Alumni Association, with no further details available: **Dwight P. Mer-**

rill, S.M.'35, of Newton, Mass., on December 27, 1984; and **Walter E. Mutter**, Ph.D.'49, of Poughkeepsie, N.Y., in November 1984; Mutter was senior physicist at IBM, Hopewell Junction, N.Y., at the time of his death.

IX PSYCHOLOGY

John M. Hollerbach, Ph.D.'78, and **Steven Pinker** have been promoted to the rank of associate professor in the department at M.I.T. Hollerbach's specialty is the control of movement in biological and robotic systems; he was a research scientist in the department and the Artificial Intelligence Laboratory from 1978 to 1982 and during that period won a Presidential Young Investigator Award. Pinker, who came to M.I.T. in 1982 after teaching appointments at Harvard and Stanford, is codirector of the Center for Cognitive Science, where he conducts research in developmental psycholinguistics and visual cognition.

Morton Deutsch, Ph.D.'48, professor of psychology and education at Teachers College, Columbia University, New York, is the author of *Distributive Justice: A Social-Psychological Perspective* (Yale University Press, 1985, \$27.50). The title refers to the fairness of allocation of goods that affect individual well-being—questions such as: How much of a school's resources should be devoted to students who are physically handicapped? Theories on such questions have occupied most of Deutsch's career as psychologist/philosopher.

Professor **Mary C. Potter**, in the department at M.I.T., known for her innovative advances in the field of human information processing, has been elected chairman of the faculty at M.I.T., succeeding Professor **Arthur C. Smith** of the Department of Electrical Engineering and Computer Science. The second woman in that post, Potter will serve for two years—through June 1987.

XII EARTH, ATMOSPHERIC, AND PLANETARY SCIENCES

The department was represented in space for a week beginning the end of July by **Anthony W. (Tony) England**, '65, mission specialist aboard *Challenger*. England was selected for astronaut training in 1967 while working for his Ph.D. with Professor **M. Gene Simmons**, and he finally received his doctorate in 1970.

Two members of the department at M.I.T. have been promoted to the rank of associate professor: **Kerry A. Emanuel**, a specialist in mesoscale atmospheric dynamics who was at the University of California at Los Angeles before coming to M.I.T. in 1981, and **Paola M. Rizzoli**, a native of Italy who completed her Ph.D. in 1978 at Scripps Institution of Oceanography in the field of physical oceanography. . . . **Leigh H. Royden**, Ph.D.'82, Kerr-McGee Career Development Assistant Professor at M.I.T., has received a NATO postdoctoral fellowship to continue studies at the Technical University of Istanbul, Turkey. . . . **Burrell C. Burchfiel**, Schlumberger Professor of Geology at M.I.T., has been awarded a Guggenheim Fellowship for research on the alpine collisional mountain belt of the southern Balkans.

Agnes M. Galligan, '55, of West Roxbury, Mass., passed away in 1984; no further details are available.

XIII OCEAN ENGINEERING

Paul D. Sclavounos, Ph.D.'81, whose field of research is the interaction between water waves and marine structures (he is largely responsible for a technique for predicting the motions of ships in waves), has been promoted to the rank of associate professor in the department at M.I.T.

Oliver H. Porter, S.M.'66, has joined the faculty of the newly approved Shipbuilding and Marine Technology Program at the University of

New Haven (Conn.); he will teach in the field of shipbuilding. . . . **Lawrence K. Donovan**, S.M.'71, commander of the Chesapeake Division of the Naval Facilities Engineering Command, retired from the Navy last August. As of this writing, his post-retirement plans were undecided.

XIV ECONOMICS

Institute Professor **Paul A. Samuelson** of M.I.T. was elected a fellow of the American Association for the Advancement of Science late last spring.

. . . Research by Professor **Stanley Fischer** of M.I.T. on the causes, effects, and control of high inflation rates will be supported by a Guggenheim Fellowship during the coming year.

Philip Kotler, Ph.D.'56, reports his recent activities: He recently co-authored *The New Competition: What Theory Z Didn't Tell You About—Marketing* (Prentice-Hall, 1985). The book is the first to describe the role played by Japanese marketing strategies and tactics in identifying, entering, penetrating, and dominating international markets. The Japanese are described as "master marketers" and their model of marketing is being increasingly copied by other Pacific Rim countries. Kotler also coauthored *Strategic Marketing for Educational Institutions* (Prentice-Hall, 1985), which describes the marketing strategies that colleges and other educational institutions can use to survive in an increasingly competitive environment. In Portugal (last June 21), Kotler was awarded the Prize for Marketing Excellence of the European Association of Marketing Consultants and Sales Trainers. . . . **William W. Keefer**, '50, chairman of Warner Electric Brake and Clutch Co., has been elected a director of Regal-Beloit Corp., South Beloit, Ill.



E. Moscovitch

Edward Moscovitch, Ph.D.'66, has joined Charles River Associates, Boston, as vice-president. Moscovitch's areas of expertise are in state and local government finance, regional economics, health care, and the technoeconomic aspects of government policy analysis. Prior to this appointment, Moscovitch was vice-president of Data Resources, Inc., in charge of the state government consulting group.

XV MANAGEMENT

Promotions to the rank of associate professor have come to six members of the Sloan School faculty: **Katharine G. Abraham** (Ph.D. Harvard '82), whose specialty within the field of industrial relations is wage determination; **Max H. Bazerman** (Ph.D. Carnegie Mellon '79), an expert in human judgment and decision processes; **Thomas W. Malone** (Ph.D. Stanford '80), whose field is the design of computer systems and interfaces; **Terry A. Marsh** (Ph.D. Chicago '81), a major contributor to financial economics; **John D. W. Morecroft**, Ph.D.'79, whose fields are system dynamics and corporate strategy and policy; and **Ram T. S. Ramakrishnan** (Ph.D. Northwestern '81), known for research on theoretical accounting issues using information economics.

Amar Gupta, postdoctoral associate, and **Hoomin D. Toong**, '67, research associate, are co-au-

thors of *Insights Into Personal Computers* (New York: IEEE Press, 1985, \$29.50), a summary of "essential information for personal computer applications in business, education, and science/engineering." It's a republication, in book form, of a series of essays by industry leaders first assembled for a special issue (1984) of the *Proceedings of IEEE*, of which Gupta and Toong were guest editors.

A signal honor from his colleagues for **Franco Modigliani**, Institute Professor and professor of economics and finance in the Sloan School: he holds the James R. Killian, Jr., Faculty Achievement Award for 1985-86. The choice was made by a faculty selection committee, who designated Modigliani for "extraordinary professional accomplishments and service to the Institute"; the award carries a \$5,000 honorarium. Modigliani is internationally recognized for work on monetary theory, capital markets, corporate finance, macroeconomics, and econometrics, and he will deliver one or more Killian lectures next spring.

Teri E. Huttner, S.M.'79, is president of the Huttner Group, computer consulting and system design, specializing in micro-computer systems in the financial area and lives in Newton Upper Falls, Mass. . . . **William E. Wade**, S.M.'68, former vice-president for land acquisition and management at Arco Exploration Co., is now vice-president for corporate planning at the Atlantic Richfield Co., Los Angeles. . . . **Nariman Minoocher Deboo**, S.M.'69, assistant vice-president of financial planning and analysis at American Express International Banking Corp., New York City, has been awarded the certificate of the Institute of Management Accounting, after completing the required two years of accounting experience and a comprehensive examination.

Judy C. Lewent, S.M.'72, has been promoted to executive director of financial evaluation and analysis for Merck & Co., Rahway, N.J., responsible for the financial activities of research and development and manufacturing, and for the financial evaluation of major capital projects. Ms. Lewent will continue as the company's controller, a position held since 1983. . . . **Alan M. Cody**, S.M.'74, formerly a senior manager at Mitchell and Co., has joined the Strategic Planning and Organization Counseling Unit of Arthur D. Little, Inc., Cambridge. As a senior consultant, Cody will focus on corporate strategy and competitive positioning in a broad range of industries.

Walter W. Powell, associate professor of behavioral and policy sciences in the Sloan School, is the author of *Getting into Print: The Decision-Making Process in Scholarly Publishing* (University of Chicago Press, 1985, \$19.95). The book presents case studies of "Apple" and "Plum" Press, publishers of scholarly books, focusing on the work of the acquisitions editor, answering such questions as how an article is selected for print and defining what is "good" social science research.

Joseph A. Crutcher, S.M.'42, of Fullerton, Calif., passed away in April 1985; no further details are available.

Sloan Fellows

Ormand J. Wade, S.M.'73, president and chief executive officer of Illinois Bell Telephone Co., has been elected a director of Illinois Tool Works, Inc., Chicago. . . . **John R. Green, Jr.**, S.M.'66, is president and chief operating officer of Magic Chef, Inc., Cleveland, Tenn. Formerly, Green was president of the firm's Admiral brand division. . . . **Goff Smith**, S.M.'53, has retired as director of Nalco Chemical Co., Oak Brook, Ill.

Samuel J. Davy, S.M.'58, has been elected a vice-president of Arthur D. Little, Inc., Cambridge. Davy joined the firm's Management Counseling Section in 1975, specializing in corporate development programs, analyses of the feasibility of new enterprises, and strategy development programs. . . . **Louis P. Buglioli**, S.M.'77, has resigned as president, chief operating officer, and director of Telecredit, Inc., Los

Angeles. . . . **Brian J. Kelly**, S.M.'73, has been named group president for information products and services of Bell Atlantic Enterprises Corp., Philadelphia, Penn. Kelly is responsible for information equipment sales and maintenance of four Bell Atlantic subsidiaries. . . . **Richard D. Johnson**, S.M.'82, who for more than 20 years was employed at the National Aeronautics and Space Administration, most recently as chief of the Biosystems Division at NASA's Ames Research Center, has joined SRI International, Menlo Park, Calif., as a senior technology consultant. He will work on SRI's space commercialization program.

Joseph Phillip Samper, S.M.'73, executive vice-president of Eastman Kodak Co., has been elected a director of Armstrong World Industries, Inc., Lancaster, Penn. . . . **Leroy E. Day**, S.M.'60, is doing consulting work in the U.S. and overseas in commercial space developments and the Space Station Program.

Dean E. Cogswell, S.M.'51, a retired second vice-president and director of personnel for the New England Life Insurance Co. of Boston, passed away on May 11, 1985. Cogswell served in the Army during World War II, rising to the rank of lieutenant colonel; he was a former deacon and superintendent of the Sunday school for 25 years in the First Church of Wenham, Mass. . . . **Walter C. Kottmann**, S.M.'69, of Clarendon Hills, Ill., passed away on May 5, 1984; no further details are available.

Senior Executives

James C. Phelps, '61, president and chief operating officer of Tesoro Petroleum Corp., has been elected a director of Nicklos Oil & Gas Co., Houston, Tex. . . . **John F. Naylor**, '79, has become corporate vice-president of the Singer Co., Stamford, Conn., retaining his position as president of the Asia division. . . . **Charles R. Sitter**, '68, executive vice-president of the Exxon Co., U.S.A. Division, has been named a director of the parent Exxon Corp., New York City.

Management of Technology Program

Charles A. Berry, S.M.'83, came to M.I.T. with a Pilkington colleague for a visit in June. He was as enthusiastic as ever about his work at Pilkington. The company wants to open up participation in the program at M.I.T. to more of their divisions, so we may be seeing applicants from Brazil and Germany down the road! Charles managed to visit with **Jane Morse** and **Ed Roberts**, '57, and have lunch with **Jim Utterback**, Ph.D.'69, while here, and also had a chance to visit with **Tony Purdie**, the current Pilkington participant in the program. Charles showed off some wonderful pictures of his daughter, Isla, and said Irene and Isla often travel to Glasgow with him to look in on the grandparents while he is on business.

Richard H. Bullen, S.M.'82, showed up in June at the Sloan School's New York summer gathering for New York area Sloan graduates. He asserted he still really loves his work with Bullen Management. "It's just me and my father," he explained, which he feels is perfect for him. He looked great and obviously is thriving on being his own boss. His wife, **Chris** (S.M.'76, Sloan School), was also there, and it was fun for Jane Morse to catch up with both of them. . . . **Koichi Kodama**, S.M.'84, also made it to the Sloan School's New York summer gathering. He brought his wife, Miyuki, and they somehow found time to really enjoy themselves in New York. His position with Mitsubishi still keeps him travelling quite a bit "all over the U.S. looking for high-tech opportunities." His wedding last March went very well, and he and Miyuki had a week's honeymoon in Hawaii. When last heard from in June, they were planning a drive through the mountains of New England this summer.

Kenneth W. Miller, S.M.'82, called in July to announce his new position and his move, ironi-

cally, back to North Carolina. On July 15, he started with AT&T Federal Systems in Greensboro as department chief for advanced technology business development. He says that, for the first time in ten years, he's using both his undergraduate and graduate education at the same time! He and Joan hadn't found a new house at the time of that writing but felt very optimistic. (Ironically, he says, the moving van had just left to move them to New York for his Duracell promotion when he found out about this position.) Ken also made it to the Sloan's New York summer gathering, completing the reunion of three MOT's at that affair. Ken hopes to make it up to Cambridge now and then, as his company owns Internometrics here.

Jane Morse had a lovely vacation in Norway in July and managed to reach **Hakon Myhre**, S.M.'83, by phone while in Oslo. Hakon is doing information systems for det Norske Veritas and seems to be enjoying it fine. He says Greta is well and that the children are growing fast and will start school soon. He had a terrible cold when he talked with Jane, but was anticipating their vacation at the end of July.

Bill (Wilbur B.) Vanderslice, S.M.'83, reports that a new group executive at IBM is keeping everyone hopping, including Bill. He and his wife, **Charlene**, moved to Darien, Conn., in April, where they are ten minutes away from the water and their boat. Bill is most excited, however, about a new business he and Charlene have bought that keeps Charlene busy full time. Next time you're passing through Darien, stop off at "Finders Keepers," a specialty boutique for fashion designer clothes, furs and accessories. The Vanderslices may have a deal for you.—Jane Morse, Program Manager, M.I.T., Room E52-125, Cambridge, MA 02139

XVI AERONAUTICS AND ASTRONAUTICS

Two members of the department at M.I.T. have been promoted to the rank of associate professor: **Joseph H. Haritonidis**, an internationally recognized fluid dynamicist with degrees from Brown and the University of Southern California; and **Robert V. Kenyon**, an authority on the physiology of eye movement in relation to man-machine interaction who joined the M.I.T. faculty in 1979 upon completing academic work at the University of California at Berkeley.

Robert C. Seamans, Jr., Sc.D.'42, was honored last summer with the 1985 Willard F. Rockwell, Jr., Medal of the Technology Transfer Society; Seamans is Henry R. Luce Professor, Emeritus, of Environment and Public Policy at M.I.T.

Steven F. Bauml, S.M.'71, is currently a vice-president in the Airlines, Airframes, and Aerospace Division of Bankers Trust Co., New York. . . . **Peter M. Bainum**, S.M.'60, reports some of his recent activities: appointed director of International Programs for the American Astronomical Society (1984); elected corresponding member of the International Academy of Astronautics (1985); and appointed vice-chairman of the International Astronautical Federation—Astrodynamics Technical Committee (1984).

Rear Admiral **Wayne E. Meyer**, S.M.'61, U.S. Navy, deputy commander for weapons and combat systems at the Naval Sea Systems Command, was awarded the Harold E. Saunders Award of the American Society of Naval Engineers at its 68th annual banquet last May. Meyer was recognized for his outstanding accomplishment in the field of naval engineering. He is credited with major contributions in the applications of guided missile systems to naval craft. . . . **Holt Ashley**, Sc.D.'51, professor in the Department of Aeronautics/Astronautics and Mechanical Engineering at Stanford University, has been elected a councilor to the National Academy of Engineering. . . . **Stanley A. Milora**, Ph.D.'72, a researcher at the Oak Ridge National Laboratory Fusion Energy Division (ORNL), has received the 1984/85 Outstanding Technical Accomplishment Award from the American Nuclear Society. Milora and a col-

league, with whom he shared the award, were cited for their work "in the theory and development of the pellet injection technique for fueling fusion energy devices."

XVII POLITICAL SCIENCE

W. Russell Neuman, who joined the M.I.T. faculty in 1980 to work in communications and political behavior, has been promoted to the rank of associate professor. . . . Professor **Robert I. Rotberg** has turned his research specialty—South African political development—to a new purpose, describing Namibia's Etosha National Park for the Travel Section of the *Boston Sunday Globe* (June 16): "... a splendid and little-known animal preserve . . . the facilities are simple but satisfying . . . the prices are extraordinarily reasonable, and the views, incomparable both day and night. . . . One of the most satisfying and most accessible of Africa's game parks." Other rewards, too: three hours away are "a number of important early rock paintings," and there's "the Skeleton Coast, a 200-mile stretch of wild desert along the Atlantic Ocean."

A five-year \$500,000 grant has come to M.I.T. from the Starr Foundation of New York to support students taking Japanese language studies in preparation for internships in Japan under the M.I.T.-Japan Science and Technology Program, of which Professor **Richard J. Samuels**, Ph.D.'80, is director. "The first major gift to a program of this type" in the U.S., says President Paul E. Gray, '54.

Superpower Games: Applying Game Theory to Superpower Conflict, by **Steven J. Brams**, '62, was published by Yale University Press late last spring. It's described as using "game theory to show that superpower conflict is not irrational but is instead fueled by the rational strategic calculations of leaders." As a conclusion, Brams "suggests ways to ameliorate this conflict by modifying the rules of 'superpower games'." Brams is professor of politics at New York University.

Professor **Deborah A. Stone**, Ph.D.'76, of M.I.T. has received a Guggenheim Fellowship for research on political boundaries and professional logics.

XXI HUMANITIES

Two major appointments in the department's Foreign Language and Literature Section: **E. Cary Brown**, professor of economics who served as head of the Economics Department from 1965 to 1983, now heads the Section; and **Catherine V. Chvany**, who has taught Russian at M.I.T. since 1971, has been promoted to the rank of full professor. Brown, who was also named associate dean of the School of Humanities and Social Science, will work to develop "new educational initiatives" in the field, says Dean **Ann F. Friedlaender**. A graduate of Harvard, Chvany is a specialist on Russian syntax; she is coordinator of the Institute's interdisciplinary program in Russian studies.

TECHNOLOGY AND POLICY PROGRAM

Scott Pace, S.M.'82, has taken an educational leave from Rockwell International to begin Ph.D. studies in policy analysis at the Rand Corporation Graduate Institute. . . . **Liz Muchay Chehayl**, S.M.'79, has become director of provider operations for a new HMO jointly owned by University Hospitals of Cleveland and Metropolitan Life Insurance Co. . . . **Richard Kutta**, S.M.'80, has been promoted to senior manager for corporate engineering at Seven-Up Co., St. Louis, where he will be responsible for all design and construction engineering activities.—Richard de Neufville, Chairman, Technology and Policy Program, M.I.T., Room 1-138, Cambridge, MA 02139

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Gwilym A. Price, 1895-1985

Gwilym A. Price, retired chairman and president of Westinghouse Electric Corp. who as a life member emeritus was the eldest member of the Corporation, died in McKees Rocks, Pa., on June 1 after a brief illness; he was within weeks of his 90th birthday.

Price's association with M.I.T. began in 1952 with his election to the Corporation and his appointment to the visiting committee for the Department of Aeronautics and Astronautics. He was already recognized as a leader in the electric industry and an eloquent spokesman for the business community. Price was made a life member of the Corporation in 1955 and became emeritus life member in 1967. In a tribute, David S. Saxon, '41, said Price "participated in extraordinary measure in the affairs of the Corporation and the Institute during his active years."

Price studied at the University of Pittsburgh Law School and became president of Westinghouse in 1946 after an earlier career in law and banking. He was chairman of the Board at Westinghouse from 1955 to 1967.

Louis Harris, 1897-1985

Louis Harris, '20, who taught chemistry at M.I.T. for a total of 38 years before his retirement in 1964, died in a nursing home in Weston, Mass., on May 28; he was 88.

Professor Harris' newest book, *A Short Introduction to Astronomy*, was published by Vantage Press, New York, in 1984.

Charles H. Chatfield, 1893-1985

Charles H. Chatfield, '14, retired secretary of United Technologies Corp., died in Hartford, Conn., on May 12; he was 92.

Chatfield was a pioneer in the field of aeronautics, having been one of the first naval officers assigned to the Navy's Bureau of Aeronautics at its inception in 1917. In the 1920s he was associated with airplane design projects at Wright Aeronautical Corp. and served briefly on the M.I.T. faculty before joining the

engineering staff of a predecessor of United Technologies Corp.

Chatfield was active in M.I.T. alumni affairs and was for 14 years prior to his death secretary of his class, contributing regularly to *Technology Review*.

Robert Welles, 1894-1985

Robert Welles, '15, a major supporter of M.I.T. through alumni activities in Southern California, died in Pasadena on May 4; he was 91.

Welles was president of the M.I.T. Club of Southern California in 1958, chairman of the Educational Council in Southern California from 1962 to 1973, and was named a life governor of the club in 1964, the same year he received a Bronze Beaver. Beginning in the 1950s, Welles hosted an informal supper at his home each year to introduce M.I.T. undergraduates to incoming freshmen from the Southern California area, an event that is now a club tradition.

Deceased

The following deaths have been reported to the Alumni Association since the *Review's* last deadline:

Ralph N. Whitcomb, '05; August 1972; Tuscaloosa, Ala.

Carl S. Barnes, '11; 1983.

Mrs. Oswald W. Stewart, '11; June 21, 1985; Kingston, Mass.

Charles B. Rowley, '12; December 17, 1984; Harwich Port, Mass.

Albert W. Chase, '17; April 12, 1985; Foxboro, Mass.

Robert H. Scannell, '17; January 15, 1985; Bronxville, N.Y.

James G. Strobebridge, '19; May 13, 1985; Southbury, Conn.

Louis Harris, '20; May 28, 1985; Weston, Mass.

Russell S. Hitchcock, '20; 1985; Sheepscott, Maine.

Joseph N. Wiegand, '20; January 9, 1985; Oakland, Calif.

Norman E. Ferguson, '21; July 7, 1985; Newton Center, Mass.

Philip M. Johnson, '21; March 14, 1985; Portland, Maine.

Robert J. Lawthers, '21; February 16, 1985; Puyallup, Wash.

Alan Osbourne, '21; May 18, 1985; Cabin John, Md.

Roy J. Roy, '21; 1982; Lexington, Ky.

Bjarne Colbjornsen, '22; July 11, 1984; Helsingborg, Sweden.

Morrill Thornton Dow, '22; 1985; Carlsbad, N.M.

Mrs. Harris B. McIntyre, '22; November 8, 1983; Marblehead, Mass.

Thomas H. Nixon, '22; May 21, 1985; York, Penn.

Roland L. Smith, '22; 1984; Delray Beach, Fla.

Charles H. Ducote, '23; April 16, 1985; Arlington, Va.

Melvin Molstad, '23; May 12, 1985; Philadelphia, Penn.
Milton O. Orwin, '23; December 11, 1984; Kalamazoo, Mich.
Lewis J. Powers, '23; 1985; Springfield, Mass.
Mrs. Alice C. Bishop, '25; January 20, 1982; Cranford, N.J.
Kathlyn A. Carnagey, '25; October 7, 1983; Badin, N.C.
William J. Mahoney, '25; June 12, 1985; Chatham, Mass.
Vincent B. Bennett, '26; March 1985; Ipswich, Mass.
Philip A. Hendee, '26; September 25, 1984; Charleston, W.V.
William H. Hoar, '26; April 27, 1985; Silver Spring, Md.
James S. Offutt, '26; May 14, 1985; Seminole, Fla.
Alfred P. Steensen, '26; March 30, 1985; Manchester, N.H.
Mrs. Edward J. Poitras, '28; February 16, 1985; Vero Beach, Fla.
John L. Cantwell, '29; May 8, 1985; Chicopee Falls, Mass.
Willis F. Davis, '29; April 14, 1985; Erie, Penn.
Harold C. Pease, '29; May 30, 1985; St. Petersburg, Fla.
John P. Rich, '29; November 22, 1984; Nashua, N.H.
Warren W. Walker, '29; April 20, 1985; Montclair, N.J.
John F. Guinan, '30; May 18, 1985; Arlington, Mass.
Bertwell M. Whitten, '30; June 5, 1985; Searsport, Maine.
Alexander Cameron Crosman, '32; 1985; Santa Ana, Calif.
Lawrence W. Grady, '32; June 6, 1985; South Yarmouth, Mass.
Samuel E. Paul, '32; May 4, 1985; Napa, Calif.
William D. Murphy, '33; May 22, 1985; Annandale, Va.
John B. Smyth, '33; April 3, 1985; Peekskill, N.Y.
Charles H. MacFarland III, '34; June 13, 1985; Union, Conn.
Herbert A. Morriss, Jr., '34; February 9, 1985; Manhattan Beach, Calif.
Gerald M. Reed, Jr., '34; July 4, 1985; North Quincy, Mass.
Alfred Z. Boyajian, '35; 1985; Scituate, Mass.
Willard R. Crout, '35; October 1983; Pittsburgh, Penn.
Alex G. Keiller, '35; 1985; Encinitas, Calif.
Alwin R. Knoeppel, '35; April 1984; New York, N.Y.
Robert T. Sutherland, Jr., '35; May 31, 1985; Sandy Hook, Conn.
Lincoln P. Vennard, '35; November 1984; Burbank, Calif.
Richard M. Whitmore, '35; March 3, 1985; Whiting, N.J.
Dana Devereux, '36; May 15, 1985; New Canaan, Conn.
Robert L. Alder, '37; April 6, 1985; Garland, Tex.
Melville E. Hitchcock, '37; March 9, 1985; Ivoryton, Conn.
Leslie A. Johnson, '37; April 20, 1985; Sanford, N.C.
Wayne M. Pierce, Jr., '37; May 7, 1985; Orange, Conn.
George Albert Randall, '37; June 17, 1985; Newburyport, Mass.
John A. Dodge, '39; May 1985; Wayne, Penn.
William G. Hamlin, '42; June 20, 1985; Glenshaw, Penn.
Everett L. Meley, Jr., '42; April 25, 1985; Houston, Tex.
Aurelio C. Hevia, '43; May 29, 1985; Miami, Fla.
Martin H. Winter, '43; February 10, 1985; Paramus, N.J.
Stanley Berinsky, '44; March 4, 1985; Sunnyvale, Calif.
Frederick B. Meier, '44; 1985; Monroe, Mich.
Clarence S. Howell, Jr., '45; June 7, 1985; Mercer Island, Wash.
Donal Botway, '49; May 8, 1985.
Louis Robinson, '50; March 28, 1985; Scarsdale, N.Y.
Roland F. Beers, Jr., '51; March 20, 1985; Dorset, Vt.

Robert W. Elliott, '52; May 13, 1985; Lynnfield, Mass.
Morton S. Hoppenfeld, '52; March 26, 1985.
Shanker R. Bagade, '55; January 1979; Cincinnati, Ohio.
Choji Nozaki, '55; April 16, 1985; Nagoya, Japan.
Leon A. Yacoubian, '55; April 1985; Damascus, Syria.
Dalton L. Baugh, Sr., '56; January 3, 1985; Mattapan, Mass.
Charles Diebold III, '58; June 1985; Buffalo, N.Y.
Myron P. Lepie, '58; May 9, 1985; Chestnut Hill, Mass.
Raymond A. Bruce, '61; April 13, 1985; Middletown, N.J.
Charles C. Conley, '61; November 20, 1985; Saint Paul, Minn.
Sudhanshu K. Dikshit, '61; October 1982.
Clarke E. Swannack, '61; December 12, 1984; Beloit, Wisc.
Albert L. Baker, Jr., '65; March 1985; Dunedin, Fla.
Vittorio Baldini, '75; April 23, 1985; Milano, Italy.
John B. Lamb, '77; May 31, 1985; Wellesley, Mass.
David E. Miller, '79; July 1, 1985; Edwards AFB, Calif.
David J. Shapiro, '87; June 19, 1985; Concord, Mass.

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Playing 20 Hands With No Winners, and the Feeding of Cats and Explorers

Since this is the first issue of a new academic year, I once more review the ground rules under which this department is conducted.

In each issue I present five regular problems (the first of which is chess, bridge, or computer-related) and two "speed" problems. Readers are invited to submit solutions to the regular problems, and three issues later one submitted solution is printed for each problem; I also list other readers whose solutions were successful. For example, solutions to the problems you see below will appear in the February/March issue. Since I must submit that column sometime in November (today is July 19), you should send your solutions to me during the next few weeks. Late solutions, as well as comments on published solutions, are acknowledged in the section "Better Late Than Never" in subsequent issues.

For "speed" problems the procedure is quite different. Often whimsical, these problems should not be taken too seriously. If the proposer submits a solution with the problem, that solution appears at the end of the same column in which the problem is published. For example, the solutions to this issue's "speed" problems are given below. Only rarely are comments on "speed" problems published or acknowledged.

There is also an annual problem, published in the first issue of each new year; and sometimes I go back into history to republish problems that remained unsolved after their first appearance.

Problems

OCT 1. We begin with a bridge problem from Lawrence C. Kells, who writes that a friend directed a duplicate bridge tournament in which every hand was played 20 times. One of these hands produced a strange result. At four of the tables the final contract was one club, played once from each of the four sides. At four of the other tables it was played at one diamond once from each side. At the remaining tables it was played once from each side at one heart, one spade, and

one no-trump. Every one of these contracts was set. Analysis of the hand proved that none of the declarers made a mistake in play. Unfortunately, Mr. Kells failed to see what the deal was. Can you reconstruct it? (That is, a deal where any contract anybody bids can be set no matter how hard he tries to make it.)

OCT 2. Smith D. Turner (jdt) has a question about the following nim-like game, called the game of thirty-one, that was popular with New York City magicians about 40 years ago:

Twenty-four cards, the 1-6 of each suit, are put face-up on the table. Two players pick up alternately, each keeping track of his pip-total. One wins by hitting *thirty-one*, or forcing one's opponent to exceed 31. Does the first or second player have a sure win, and how does he play to insure it?

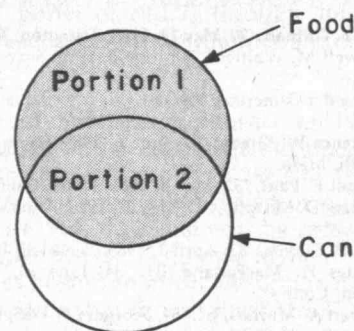
OCT 3. Albert Mullin asks us an educational problem:

A very wise dean wishes to improve the quality of research and education at her university. She believes some of the "fault" is with the department heads, but, being wise, recognizes some of the "fault" may be with herself. For starters, she decides to relocate her office so as to *minimize* the average distance to her department heads. Where should she locate her office? (For simplicity, assume all offices are located in a plane and that the dean cannot co-reside with any department head).

OCT 4. Yogesh Gupta posted the following problem on an electronic bulletin board that I read:

An exploring team wants to reach a destination that is six days away. Each explorer can carry enough provisions to sustain one person for four days (and the distance an explorer travels in a day is independent of the amount of provisions he or she is carrying). What is the smallest team that permits at least one explorer to reach the destination and permits all the explorers to return home safely?

OCT 5. John Glenn has two cats, which are fed a single can of cat food. The food comes out of the can as a single intact cylinder, and the can is then used to cut the cylinder into two shares of food. Where should the can be positioned to generate equal shares?



Speed Department

SD 1. Phelps Meaker wants to know at what time between two and three o'clock the hour and minute hands are in a symmetrical position.

SD 2. We end with a series of "chemistry" questions from *The Tech*, M.I.T.'s student newspaper:

Give the names of the following compounds:

1. $\text{WaN aCrKrWaNaCrKrWaNaCrKrWaNaCrKrWaNaCrKr}$

2. $\text{Be} + \text{Ar}$

3. BaAuHIJ KLMnO

4. $\text{HI O}_2 \text{ Ag}$

5. $(\text{BaNa}_2)_{12}$

6. 

7. 

8. 

9. 

10. 

11. 

12. 

13. 

14. 

Solutions

M/J 1. How does South make five clubs after an opening lead of the ♦Q, and what lead sets this contract?

♠ A 8 4	♠ Q J 10 3 2
♥ A K 10	♥ 8 6 5
♦ A 7 6 5 4	♦ J
♣ K J	♣ 10 7 5 4
♠ K	
♥ Q J 9 4 3 2	
♦ Q 8 3 2	
♣ Q	
♠ 9 7 6 5	
♥ 7	
♦ K 10	
♣ A 9 8 6 3 2	

Benjamin Feinswog suggests winning the opening lead with the ♦K and then cashing the ♠K and ♣J, discarding a spade. Now the ♥10 is ruffed and the ♠A cashed. At this point the ♦10 is led and, whether East ruffs or not, the ♠A provides an entry to the ♦A permitting a second spade discard. Thus South loses only one spade and one trump. Mr. Feinswog notes that a lead of the ♦2 (among others) will set the contract.

Also solved by Richard Hess (who believes that any lead will set the contract), Matthew Fountain, and the proposer, Doug Van Patter.

M/J 2. A large bed of flowers and greenery is laid out in the form of a regular polygon of N sides. A walk composed of N trapezoidal concrete slabs surrounds the flower bed. A circumscribing circle passing through the outer corners of the walk and an inscribing circle tangent to the inner flats of the trapezoids have circumferences in the ratio of almost exactly 191:165. The total area within the outer periphery of the walk and the area of the walk itself are in the ratio of 4:1. Find N .

The following solution is from Richard Heldenfels:

The general equations of regular polygons and a trigonometric relationship were all that was required to obtain a direct solution. The ratio of circumscribing and inscribing circles provides the following:

$$a_o \tan(180/N) / a_i \sin(180/N) = 191/165,$$

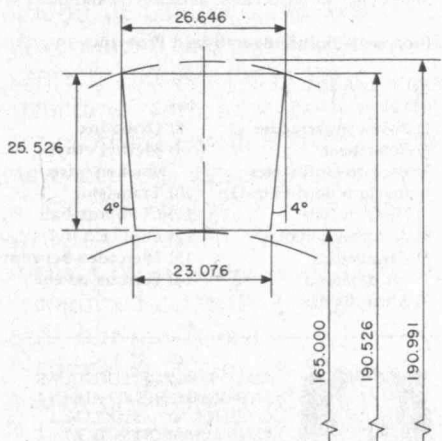
where the a 's are the length of the outer and inner sides and N is the number of sides. The ratio of areas provides the following:

$$A_1/A_0 = (a_1/a_0)^2 = 3/4.$$

These equations can be combined and simplified to yield:

$$\cos(180/N) = (165/191)(2/\sqrt{3}).$$

The solution is: $180/N = 4.0391^\circ$. Since the ratio of circles was not exact, $N = 45$. The ratio of 191:165 is greater than that ratio for $N = 45$ polygon by the factor of 1.000048. A drawing of one trapezoidal concrete slab follows:



Also solved by Charles Freeman, Dennis White, Frank Carbin, George Parks, Harry Zarembo, John Prussing, John Woolston, Matthew Fountain, Michael Jung, Naomi Markovitz, Richard Hess, Steve

Feldman, and the proposer, Phelps Meaker.

M/J 3. Given a number N between 500 and 1000, rapidly construct a series of numbers using eight of the nine digits from 1 through 9 once, the other digit twice, and a few zeroes so the series totals N .

Naomi Markovitz must have spent a great deal of time in tricky parlors:

HTU	HTU	HTU	HTU
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9
			3

Being that as many zeros as desired may be used, I'll worry about whether the other digits should be in the hundreds, tens, or units column and then affix the appropriate zeros in the presentation of the requested series. I noticed in the example presented that most of the non-zero digits are in the tens column. Indeed the sum of $10 + 20 + \dots + 90 = 450$, which is the same order of magnitude as any answer which may be requested. Therefore, my approach would be to start with one "copy" of each digit in the tens column and then to check, in the case of each sum desired, which digits have to be moved to the hundreds column, which to the units column, and which has to be duplicated (and the column in which the second copy will appear). If a digit, a , moves from the tens to the hundreds column, the sum will increase by $100a - 100a = 90a$. If a digit, b , is moved from the tens column to the units column, the change is $-10b + b$, or a decrease of $9b$. Take, for example, the case which is presented in the problem: $N = 642$. I start off with the arrangement at the left of the box above. This gives a total of 450. I have to add $642 - 450 = 192$. To check which digit has to be moved to the hundreds column, I divide 190 by 90 and get 2+. I'll move 3 to the hundreds column, because if I add too much, I can subtract the extra by moving a digit to the units column. Now I have the second display in the box. I've added $3 \times 90 = 270$, instead of the required 192, so I'll have to subtract 78. To determine which digit to move to the units column, I divide 78 by 9 and get 8+. Again, I chose to subtract "too much" because this problem can be solved by adding the second copy of one of the digits. So I'll move the 9 into the units column. Now I have the third display in the box. I have subtracted $9 \times 9 = 81$ instead of the required 78. I have to add $81 - 78 = 3$. I therefore add a second 3 to the units in the fourth display. So, the answer can be presented as:

319
20
40
50
60
70
83
642

There are, however, cases in which the procedure must be slightly modified. The basic procedure will work in all cases since:

$$500 \leq N \leq 1000$$

we see that

$$50 \leq N - 450 \leq 550.$$

Dividing by 90 will always give an answer in which a single digit must be moved to the hundreds column. (Even if the division comes out even, add 1 to the quotient to determine the digit to be moved, because eventually a second copy of one digit will have to be added.) The second stage consists of dividing by 9 a number from 1 to 90. Several problems could occur:

(1) The number that has to be moved from the tens

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F. W. Clark, '79
K. A. Fogarty, '81
W. E. Hodge, '79
C. A. Lindberg, '78
R. T. McGillivray, '68
C. A. Mendez, '85
J. D. Okun, '75
K. J. O'Reilly, '80
R. M. Simon, '72
T. von Rosenvinge IV, '80
W. G. Williams, '65
D. W. Wood, '76

Other Offices:
Bridgeport, CT
Vernon, CT
Tampa, FL
Manchester, NH
Buffalo, NY
Providence, RI

column to the units column is no longer in the tens column, because it has already been moved to the hundreds column. Solution: If $b \geq 3$, move both 1 and $b - 1$ (or any other combination of 2 numbers totaling b) into the units column. If $b = 2$, instead of moving 2 into the hundreds column (for a gain of $2 \times 90 = 180$), move the 3 into the hundreds column and then $1 + 9$ (or any other combination totaling 10 other than $2 + 8$) into the units column: $3 \times 90 - 1 \times 9 - 9 \times 9 = 180$

The 2 will then be available to move into the units column.

If $b = 1$, instead of moving 1 into the hundreds column, move 2 into the hundreds column and either 3 and 7 or 4 and 6 into the units column. The 1 will then be available to be moved into the units column.

(2) It's required to move 10 or 11 into the units column. Solution: Move in two numbers with the appropriate sum. There will always be a pair available, because the original list (1 - 9) consists of four pairs totaling 10 and four pairs totaling 11. Since only one digit has been removed from the tens column, enough choices still remain. The last stage always gives a number from 1 to 9 that can be added, so this can be accomplished by placing the appropriate single digit in the units column.

Also solved by Mathew Fountain, Richard Hess, Steve Feldman, and the proposer, Lester Steffens.

M/J 4. As we generate geometric figures to represent $y = x^n$, we have "elements" consisting of points, lines, faces, cubes, etc. as n increases. For the number of points in each figure, we have (for $n > 0$) $P = 2^n$. Derive the number of lines and faces in a five-dimensional hypercube.

Charles Sutton solved a generalization of M/J 4: We may consider the generation of the sequence of n -dimensional cubes, d units on a side, as follows: A cube of any number of dimensions, moved a distance d in a direction perpendicular to all its dimensions, will generate a cube of one higher dimension. If one starts with a zero-dimensional cube (a point), this procedure will generate, in succession, line segments, squares, cubes, and so on into cubes of higher dimensions (hypercubes). Note that an n -dimensional cube will have as components all cubes of lower dimensions, from zero-dimensional points up to $(n - 1)$ -dimensional cubes. Now when an n -dimensional cube is moved a distance d in the direction of the next higher dimension to generate an $(n + 1)$ -dimensional cube, its r -dimensional component cubes ($0 \leq r < n$) will necessarily generate $(r + 1)$ -dimensional components of the $(n + 1)$ -dimensional cube. It is clear that the number of points will double, since there will be just as many points in the final position of the cube as in the initial position, and hence the number of points (zero-dimensional components) in an n -dimensional cube will be 2^n . When an r -dimensional component ($r \geq 1$) of an n -dimensional cube moves a distance d , there will be just as many such components in the final position as in the initial position, but there will be additional r -dimensional components generated by the motion of $(r - 1)$ -dimensional components. Hence the number of r -dimensional components in an $(n + 1)$ -dimensional cube can be obtained by adding the number of $(r - 1)$ -dimensional components to twice the number of r -dimensional components in an n -dimensional cube. We can use this to complete the array at the top of the next column, giving the lower dimensional components for cubes of each number of dimensions. Filling in 1's in the diagonal (since an n -dimensional cube can be considered to have itself as a component) and powers of two in the left hand column, we can continue by adding twice the value of any entry to its left hand neighbor and writing the result below the doubled entry. The construction of this array is reminiscent of Pascal's triangle, and in fact the numbers in the rows can be seen to be the coefficients in the expansion of $(2x + 1)^n$. And the answer to Winslow Hartford's question in M/J4 is that the numbers of lines and faces in a five-dimensional hypercube are both 80.

Mr. Sutton then adds the following remarks: I have always been intrigued by the geometry of

Dimension of cube	Dimension of components						
	0	1	2	3	4	5	6
0	1						
1	2	1					
2	4	4	1				
3	8	12	6	1			
4	16	32	24	8	1		
5	32	80	90	40	10	1	
6	64	192	240	160	120	12	1
7	128	448	672	560	290	84	14

higher dimensional figures, and recall having read someplace that there are six regular four-dimensional solids but that only the analogues of the cube and tetrahedron exist for all higher dimensions. That set me to wondering what the triangular array I had obtained in my solution of M/J 4 would look like for the equilateral triangle, regular tetrahedron series. Actually it's fairly easy, since to step up one dimension you need only to find a point in the next higher dimension that is the same distance from the set of equidistant points in the lower dimensions. The n -dimensional analogue of the tetrahedron would have $n + 1$ vertices, and the number of its r -dimensional components (each having $r + 1$ vertices) would be the number of combinations of $n + 1$ things taken $r + 1$ at a time. Binomial coefficients! And the numbers in the horizontal row of the triangular array corresponding to the n -dimensional analogue of the tetrahedron turn out to be the coefficients of $(x + 1)^{n+1} - x^{n+1}$. As a check, for $n = 3$, a tetrahedron has four vertices, six edges, four faces, and one tetrahedron, coefficients of $(x + 1)^{4} - x^4$.

Also solved by Avi Ornstein, Charles Freeman, Dennis White, Matthew Fountain, Richard Hess, and Winslow Hartford.

M/J 5. Take the letters in the first half of alphabet in order. Place the A on the table. Place the B next to the one of the four sides of the A. Place the C next to one of the six sides at the AB (or BA) pair. Then add the D and so on. If you do this correctly, when you reach the letter M you will have created a crossword-puzzle matrix of complete common English words, no proper names, no foreign words, and no acronyms or abbreviations. Having solved the problem as posed, can you add one or more letters to the A-M set and still retain complete words?

Both Rik Anderson and Matthew Fountain found the identical solution—one that goes up to P. The key to extending past M is the word "knap." It would be hard to go further since adding Q would require U and hence R S T.

			H		
			B	A	C
			F	E	D
			J	I	G
			L		P
			M		

Also solved by Harry Zaremba, M. Arch, Naomi Markovitz, Richard Hess, and Steve Feldman.

Proposers' Solutions to Speed Problems

SD 1. 2:46 2/11
SD 2.

- | | |
|--|------------------------------|
| 1) Polywannacracker | 8) Orthodox |
| 2) Polar bear | 9) Methyl ethyl chicken wire |
| 3) Barium Goldwater (barium gold H-to-O) | 10) Transistor |
| 4) Hi-O, Silver | 11) Cis-boom-bah |
| 5) A dozen bananas | 12) FORTRAN 4 |
| 6) Paramedics (or paradox) | 13) Mercedes benzene |
| 7) Metaphysics | 14) Ferrous wheel |



SEND PROBLEMS, SOLUTIONS, AND COMMENTS TO ALLAN J. GOTTLIEB, '67, ASSOCIATE RESEARCH PROFESSOR AT THE COURANT INSTITUTE OF MATHEMATICAL SCIENCES, NEW YORK UNIVERSITY, 251 MERCER ST., NEW YORK, N.Y., 10012.

*Broadly based R&D
partnerships could perform research that
individual contractors cannot afford.*

in salt water react with the upper layers of reinforcing bars, releasing electrons and rusting the steel. In cathodic protection, however, an electric current directed into the reinforcing bars gives them a negative charge, so they repel the chloride ions and do not rust.

Cathodic systems cost two to three dollars per square foot and use such a small current that most could run from solar cells. A few states, such as California, have used the systems on bridges, while other states have been waiting for proof that cathodic protection is effective. The wait may end soon. In a 1981 study, the FHWA found that cathodic protection of all U.S. bridges could save \$20 to \$60 billion over the next 30 years, and the agency has begun to press all states to use the systems.

Overcoming Barriers to Innovation

Regulations and codes that specify obsolete technologies often slow innovation. In many states, inspectors must examine the plumbing and wiring before a wall of a house is finished. Thus, factory construction is impossible. Also, even when they use traditional methods, contractors fear liability suits from owners.

Many people in the construction industry believe that contractors who try innovative technologies should face only limited liability. (Such limited liability would not, however, apply in cases where a manufacturer knowingly subjects workers or the public to health and safety dangers.) Some European countries have pioneered one way to reduce the likelihood of liability suits and modernize codes. The government charges a small fee on all construction projects and uses the proceeds to construct prototype structures with new methods. Once the structures are properly tested, building codes can recognize the new methods as standard.

Largely because it is so splintered, the U.S. construction industry does little research and development. Construction research is not even a generally recognized category of R&D funding. Statistics are rare, but the Transportation Research Board of the National Academy of Sciences found that U.S. research on highway construction in 1982 was only 0.17 percent of the \$1 trillion investment in highways. U.S. manufacturers of building equipment and materials do some research, but often on only one product, not the entire industry. And even this min-

imal research has declined. Though 18 U.S. cement companies had research labs before the recessions of the seventies, only 6 had them afterward.

The United States is falling behind in research on housing construction, too. In Japan, hefty research budgets and strong development programs have brought computer-based automation and new materials such as PALC to home builders. Within the next decade, Japanese manufacturers will have satisfied much of their own country's housing demand and will no doubt seek to produce houses abroad. The competition could prove too strong for American companies. As one U.S. manufacturer of prefabricated housing put it, "American plants make heavy use of pneumatic nail guns. Japanese plants feature robot welders. The difference is that we're mechanized—they're automated."

Although the U.S. construction industry is ready for a technological revolution, the opportunity will be lost without a comprehensive R&D program. The program must look beyond the industry's immediate concerns to suggest fundamental changes in methods and materials. Such an effort will require the cooperation of industry, government, and universities. To increase communication among these groups, construction executives, engineers, public officials, academics, and financial leaders might convene in a series of meetings, as they did in 1983 under the auspices of Touche Ross & Co., Prudential-Bache Securities, Inc., and M.I.T.'s Center for Construction Research and Education.

Finding money to finance research also requires cooperation. The Commerce Department has established a framework for setting up limited R&D partnerships. These guidelines minimize the possibility of antitrust suits and provide tax and other financial incentives for firms to join. Most of these partnerships, such as Microelectronics and Computer Technology Corp. (MCC), are in high-technology industries. But construction firms, research centers, investment brokers, and prospective manufacturers could form similar R&D partnerships, relieving individual contractors from bearing the entire burden. A broadly conceived research program would assure the continued vitality of the U.S. construction industry at home and abroad, strengthen the economy, and improve the life of nearly everyone.

FRED MOAVENZADEH is the William E. Leonhard Professor of Engineering and the director of the Center for Construction Research and Education in the Civil Engineering Department at M.I.T.



*New technologies
are available for dealing with America's
epidemic of toxic waste. But using them
effectively will require entirely new
managerial approaches.*

The Missing Links: Restructuring Hazardous-Waste Controls in America

BY BRUCE PIASECKI AND JERRY GRAVANDER

THE image of America as a limitless reservoir for disposing of wastes has changed dramatically since Love Canal. Each month brings more reports of the never-ending battle to contain leaking landfills, and with clockwork regularity news of toxic poisoning and groundwater contamination reinforces the public's distrust of land disposal.

Yet land disposal remains America's dominant method of managing toxic waste. Secured landfills, industrial lagoons, deep-well injection systems—each relies on America's time-worn trust in the resilience of its soils. The Environmental Protection Agency (EPA) reports that 57 percent of America's toxic wastes are now injected into deep wells, with another 38 percent kept in leaking industrial lagoons and surface storage tanks. A few firms have engineered efforts to improve land disposal. But policymakers often express despair, and citizens remain puzzled, over the prospects for adopting alternatives before the end of this century.

"We know we don't want our dumps expanded," says Keith Gowton, founder of the citizens' group Families United for a Safe Environment, "but we can't say at town meetings or in the courts what else might work." Similar statements echo through town halls from Philadelphia to Fairbanks. Yet Americans are not the first to investigate alternatives to dump-

ing. In fact, given our stubborn faith in the land as an ultimate sink, we might be among the last.

Fifteen years before hazardous-waste problems were publicly recognized in this country, several European nations had evolved regulatory and managerial systems that encourage alternatives to land disposal. In 1973, Denmark established the Kommunekemi facility in Nyborg, which now destroys over 90 percent of the nation's hazardous wastes. This integrated treatment facility also recovers heat from its toxic-waste incinerators to supply Nyborg's 18,000 residents with 35 percent of their heating needs. West Germany has coordinated the construction of 15 treatment centers that destroy the bulk of the nation's worst wastes. Other European governments, including those of Sweden, Austria, Finland, and the Netherlands, are now following these early examples by minimizing access to dumping and requiring the use of recycling, incineration, and treatment technologies. (See "A Grand Tour of Europe's Hazardous-Waste Facilities," by Bruce Piasecki and Gary A. Davis, July 1984, page 20.) Europeans destroy the same toxic solvents, dyes, and organics that we dump into our soils and surface waters.

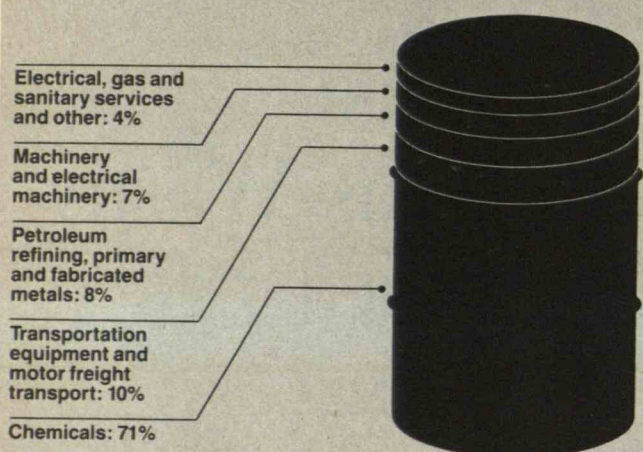
Once Americans acknowledge that there are practical alternatives to land disposal, a new series of questions arises. Can we build facilities based on European strategies that favor waste recycling and

Many U.S. landfills, such as this one near Los Angeles, are almost full. A new approach to managing toxic wastes must be adopted.

Toxic wastes originate from a variety of sources—industrial, municipal, and individual. Researchers are often unsure how specific wastes are linked to par-

ticular illnesses. However, they have no doubt that the growing amount of toxic wastes poses major health hazards to the American population.

WHO PRODUCES HAZARDOUS WASTE:



treatment? Might we finance them with the same degree of government subsidy found in Europe? Is it feasible to operate U.S. waste-treatment centers on a European model of cooperation among government, industry, and the public?

The political systems of Denmark, West Germany, and the other continental innovators differ significantly from that of the United States. Not only do their socialistic institutions contrast sharply with the free-enterprise tradition of America; they also have a long history of centralized decision making that often precludes the degree of legal access and appeal that Americans demand. Nevertheless, the European example offers one incontrovertible lesson: land disposal of toxic wastes can be replaced by superior alternatives.

The United States has had its own successes in solving pressing problems of environmental management. Faced with massive flooding, deteriorating urban water supplies, and mounting municipal sewage, this country evolved, over its first 200 years, a cooperative public-works program to solve these problems. Federal, state, and local governments coordinated the construction of an infrastructure that includes dams, water mains, and sewers. Moreover, within the past 75 years, the agricultural extension service has been developed as a joint private-public venture to maintain the vitality of our farmlands.

Both initiatives offer uniquely American models for responding to ubiquitous environmental threats—models that could facilitate the transfer of European strategies for reducing, recycling, and treating toxic waste.

A Tragedy of the Commons

A willingness to conceive of the toxic-waste problem in a public-works context may prove the most important legacy of the European example, helping U.S. leaders see beyond their inherited institutional and ideological blinders. The various European approaches, while different in detail, have three pivotal factors in common:

- ☐ A willingness to stabilize a waste-treatment market through comprehensive regulatory reforms, rather than through financial incentives that encourage individual changes in private business practice.
- ☐ A knack for cooperative financing and managing liabilities jointly between regional governments and private industries.
- ☐ A profound distrust of land disposal, despite engineering advances in constructing and monitoring landfills and lagoons.

These factors clash with some longstanding American biases. Perhaps the most crucial is the prejudice that favors upgrading existing technologies and resists adopting foreign-based innovations. In less than a decade, the United States has poured millions of dollars into patching up dumps and improving land disposal techniques. In willful defiance of thermodynamics and common sense, we have built up our dumps with precipitation caps, double liners, restraining walls, and collection systems for leaching wastes. Despite these technical reforms, the EPA estimates that we have less than 17 years of landfill capacity left in the continental United States.

Only recently have we realized that the flaw is in our thinking, not our machines. Managers first became alert to the indirect results of environmental neglect through Garrett Hardin's popular "Tragedy of the Commons." By showing that the net benefit to the individual in adding cattle to the commons also represents a hidden cost to each of the other users, Hardin exposed the insidious logic of overuse. At the heart of our current approach to toxic wastes is timidity. Each individual's fear of new responses to toxic wastes—particularly to a plant slated to be

Traditional methods dominate disposal of toxic wastes in the United States. Many European nations, by contrast, use modern technology to de-

stroy their wastes, and hence greatly reduce their health hazards. The U.S. must devise techniques for using these alternative disposal methods.

built nearby—together with a reliance on a familiar use of the land, leads to the present tragic costs to the commons. The fear is most forcefully evident in our communal failure to site safe detoxification facilities.

With over a billion gallons of PCB-contaminated oil inside a variety of electrical components in this country, the need for PCB treatment of waste oils is clear. In fact, when Congress banned further production of PCBs in 1977 and began monitoring their disposal, a number of companies designed chemical neutralization techniques.

Sun Ohio Co. was first to market, with a device in a 40-foot truck that can reduce PCB contamination from 10,000 parts per million to less than 2 parts per million. The system uses metallic sodium to strip the chlorine from the PCBs and convert it to a form of common table salt. Acurex Corp., a builder of similar dechlorination trucks, boasts innovations that can even treat contaminated soils. Pleased by the timely emergence of these trucks, the EPA has granted interstate licenses and operating permits to their builders. However, even though these devices were ready to roll as early as 1980, the last five years have seen minimal use. From Massachusetts to Nevada, town officials have ignored the EPA's assurances that the systems are safe and have opted not to use them.

Earlier this year, Environmental Services Co. (ENSCO) of Little Rock, Ark., built a portable rotary kiln that could reach temperatures high enough to incinerate PCB-contaminated soils beyond the 99.9999 percent efficiency required by law. The system was successfully tested in Tampa on a non-PCB sludge, and the EPA has contracted to use it on PCB-contaminated soils in Jacksonville. But ENSCO executives fear that their multimillion-dollar investment might be booted into early retirement because of unfounded suspicions about the system's safety.

Right now, citizens of Bloomington, Ind., are fighting over the best ways to use \$64 million won in a consent decree against Westinghouse for contaminating six landfills with PCBs. The decree represents the largest toxic-waste settlement in history and requires that the money be spent to diminish risks to the public. To do this, the town has offered to zone public land for building a treatment center, and Westinghouse has agreed to provide technical assistance in setting one up. "But the effort has remained in limbo for several years," notes Lynton

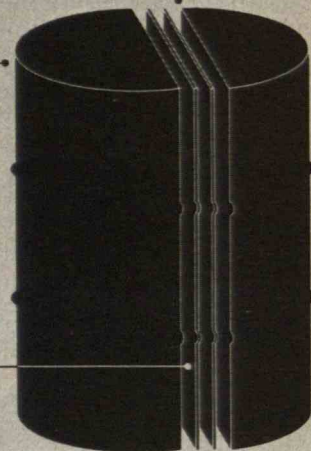
HOW HAZARDOUS WASTE IS DISPOSED OF:

Surface Storage: 38%

Underground injection
(deep burial): 57%

Landfill: 3%

Land treatment and
other: 2%



Caldwell, father of the environmental impact statement and a leading citizen of Bloomington. Because of local opposition to the proposed treatment center, Caldwell says, "There is now talk of simply covering the PCB-laden soils with plastic restrainers." Mayors often prefer delay over actions that cause controversy among blocks of constituents. But when it comes to toxic contamination, short-term political compromise often denies the possibility of long-term managerial solutions.

Whether the location is dioxin-stained Times Beach or the ribbon of developments stretching out from most cities, the core of the siting controversy remains the same. While the entire public shares in the benefits from a hazardous-waste treatment center, residents near the center incur the risks. Yet each time an effort to move beyond land disposal is thwarted, each of us pays the cost. PCBs, for example, do not biodegrade; the carcinogen concentrates in fatty tissues as it moves up the food chain.

The irony is that siting criteria often favor land disposal in insidious ways. In New York State, the Department of Environmental Conservation (DEC) published a set of 14 weighted criteria for evaluating sites for hazardous-waste treatment facilities. The criteria are designed to prevent the selection of sites that would contaminate groundwater and surface water.

However, since there are considerable differences among the regions that generate waste, the DEC allows a committee of field investigators to adjust the weights according to local conditions. Under this guise, the tragedy of timidity resurfaces. Efforts to choose land-disposal sites have received the most lenient adjustments, while attempts to establish treatment and recycling facilities have faced consistently stiffer resistance. This is not the result of a quirk but an attitudinal blindspot. The adjustments favor the maintenance costs of continued land disposal over the new costs inherent in alternatives. The known, however inadequate, is easier to calculate and defend than "uncertain" innovations.

Across the nation, similar discrepancies reign. The Internal Revenue Service, for example, precludes the use of municipal bonds to finance construction of toxic-waste recycling and treatment centers. This preference for land-disposal methods for treating waste cannot be explained only by the strength of the landfill lobbies. Despite the influence of the National Solid Waste Management Association and the Chemical Manufacturers Association in Washington, the more fundamental fault is the nation's refusal to acknowledge the tragedy to the commons.

The Limits of Liability

Americans traditionally overcome differences among entrenched positions by recourse to the courts. In the case of environmental hazards, citizen groups and government regulators have pursued legal battles with unprecedented singlemindedness, finding business liability to be their most powerful weapon. However, while this strategy is often the best means to a particular judicial end, it has been of limited use in shifting the nation beyond dumping.

There are several reasons for this. No matter how many times astute lawyers win cases against land-disposal firms, the victories are not prescriptive. Liability judgments may block specific cases of dumping but do not promote safe alternatives. Chemical companies drained of their surplus capital from suits are seldom equipped to invest \$25 million in new rotary-kiln incinerators. Waste handlers, justly fined in case after case, often walk a tightrope between spending so little that they achieve only marginal improvements and spending so much that their capital is exhausted. Indeed, bankruptcy threatens many of the larger land-disposal companies now repre-

sented by the National Solid Waste Management Association.

Liability also fails to provide adequate and comprehensive compensation, for ultimately it can go only as deep as the pocket of the violator. Just the largest companies can afford to spend up to \$30 million to completely clean up each toxic-waste site. EPA's Superfund program, officially called CERCLA (the Comprehensive Environmental Response, Compensation, and Liability Act), is designed to change this situation: the 1980 law provides EPA with the authority to finance the cleanup of 30 years of managerial mistakes. But whether this mechanism will encourage waste-treatment reform remains uncertain: most of the CERCLA wastes recovered have merely been redrummed and shipped to other landfills.

Of course, the threat of liability does encourage some significant reform. Companies such as 3M, Dow, and Kodak are recycling and incinerating their worst wastes, even though federal rules do not yet require that they do so. "Pollution prevention pays," says Don Huisinck, an environmental analyst at North Carolina State University at Raleigh, "but the trick is making most American companies click onto the concept."

Once Americans acknowledge that legal tools are a necessary but insufficient force in a nation's search for superior waste management, the European example assumes a heightened relevance. Western Europe made its shift toward treatment with minimal legal costs. Denmark and West Germany struck their critical agreements without recourse to the higher courts. The difference centers on the approach to rule making.

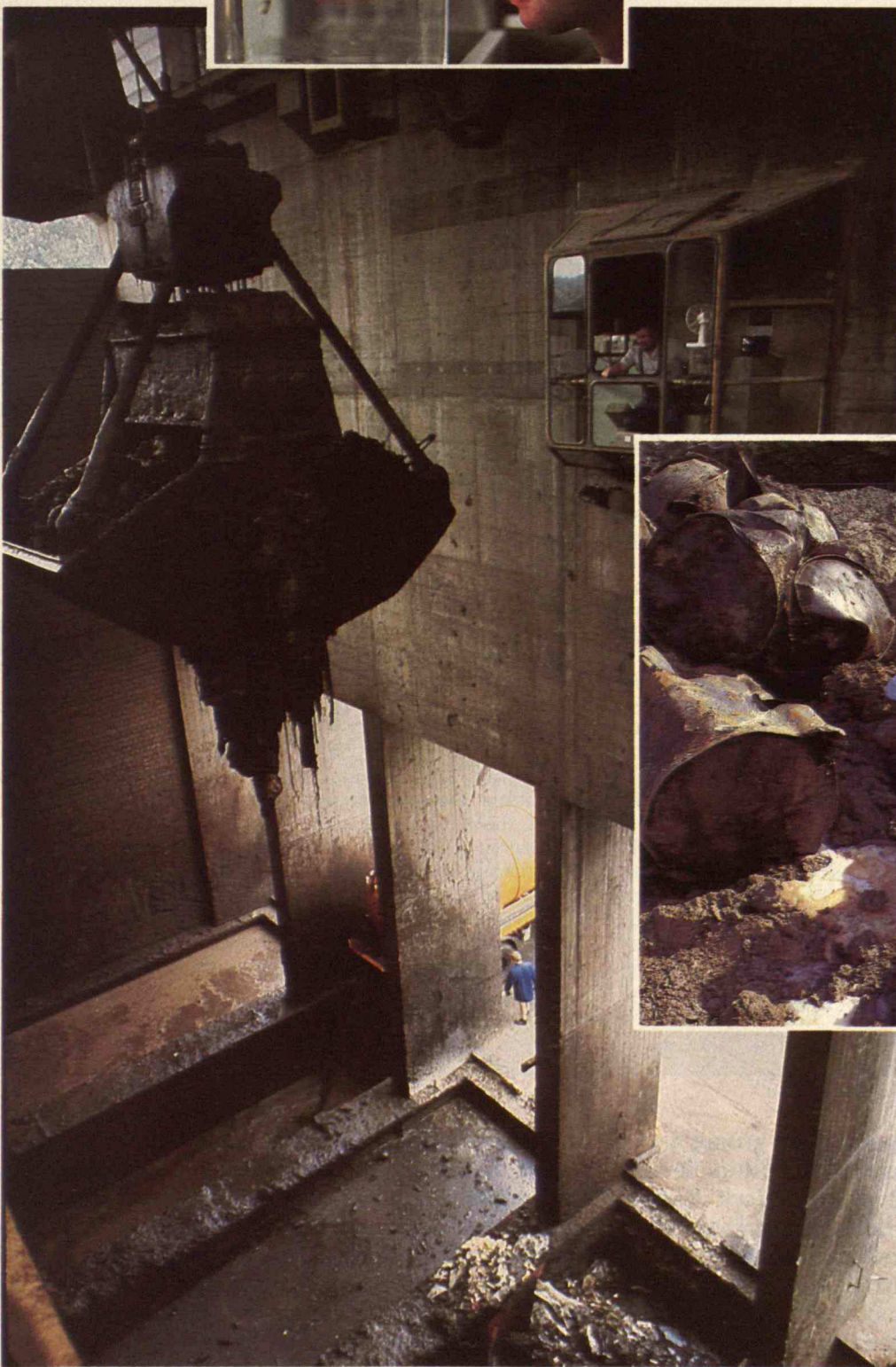
Bargaining over Risks

In the United States, regulatory rule making involves at least four basic steps. First, before the EPA proposes a rule, each interest group lobbies informally for its position. As in the recent debates over ocean incineration of toxic waste, citizens, industry, and government are pitted against one another early in an atmosphere of mutual distrust.

Second, the EPA publishes its announced notice of proposed rules (ANPRS) and holds public hearings to enable the public to respond. Opposition to the proposed regulations is often fierce and entrenched within the first few days. In the ocean-incineration



Several European nations try to destroy their toxic wastes totally. Most of the industrial wastes produced in the West German state of Bavaria are incinerated in facilities such as the one in Ebenhausen. Left: A crane operator feeds liquid and solid wastes to the furnace. Before wastewater from the plant can be released into the Paar River, it must keep guppies alive for 24 hours (inset).



Hazardous wastes found in long-abandoned dump sites keep cleanup crews busy. Above: Illegally buried drums at a site near Swartz Creek, Mich. contained cyanide, PCBs, acids, and pesticides, among other toxins. Ironically, most of the toxic wastes removed through the EPA's Superfund program have been re-drummed and buried elsewhere.

Compensating Toxic-Waste Victims

BY FRANK P. GRAD

Our society has not decided how to dispose of hazardous waste harmlessly, and we do not quite know how to deal with injuries from exposure to it. The two sets of issues are related, and their resolution is hindered by uncertainties in both technology and law. If a safe and technologically and economically efficient way to dispose of toxic waste were established, the legal problems would eventually disappear, and lawyers, industry and insurance companies would no longer have to worry about victim compensation. Because no such system of disposal is about to emerge, the problem will continue to trouble industry, insurers, and lawyers for plaintiffs and defendants.

Victim compensation has remained a public issue since Congress debated the Superfund law in 1980. But despite mounting evidence of the health dangers from toxic waste, very few victims have brought claims, and even fewer lawsuits have gone from claim to judgment. This has led industry and insurers to assert that there is no problem, or that proponents of victim-compensation legislation greatly exaggerate it. Unfortunately, the problem is enormous, even though it is

difficult to predict how many people will ultimately be affected.

The victims of exposure to toxic waste are in the same position today as victims of exposure to asbestos about 30 years ago: there were few acknowledged cases of asbestos-related disease because many of the thousands of people who had been exposed showed no symptoms. Industry and insurers asserted that there was no problem.

Illness from exposure to toxic waste is even harder to deal with because it is more variegated and diffuse. People are mainly exposed to asbestos in the workplace, and the substance causes a small number of recognizable diseases, such as asbestosis, that can be only attributed to it. Exposures to hazardous waste, on the other hand, are ubiquitous, and the variety of substances involved makes it difficult to establish the specific causes of disease. Often we do not know to what extent illness is dose-related, or related to the synergistic effects of many substances from a single disposal site.

To estimate the size of the exposed population, we must know how many disposal sites exist. But experts cannot agree on that number. An industry-sponsored study in the

early eighties found 4,802 such sites nationwide, while a government-sponsored study found 50,000. And more sites are being discovered regularly.

The public's exposure to toxic waste also depends on the density of population near disposal sites, and on the path of exposure. Unfortunately, toxic waste percolates through groundwater slowly, and its movement underground is difficult to track. We can drill test wells to monitor this movement, but not without risking further contamination. Monitoring the health of the population itself is just as troublesome, because many people have already been exposed to high concentrations of chemicals in industry or from nature.

In sum, we know that thousands of people are exposed to hazardous waste, but we cannot assess its effects until we have better data on exposure and its relationship to illness. Our experience with workplace exposure to hazardous chemicals suggests that many cause latent illnesses, including cancer, and mutagenic effects that will emerge in persons as yet unborn.

Nevertheless, alleged victims are beginning to bring claims. These suits have a



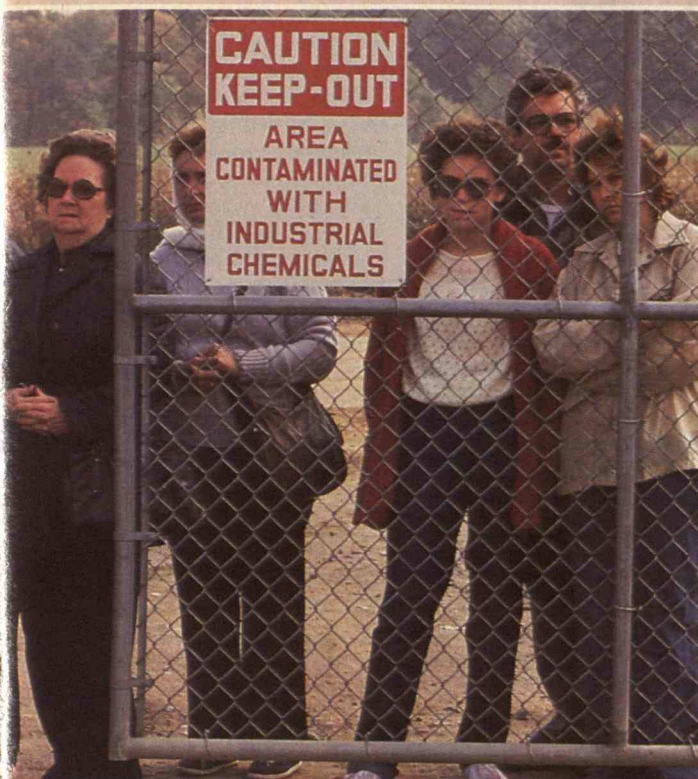
number of common elements: They often involve multiple plaintiffs, aim at multiple defendants, and seek large damages. In *Kennedy v. Scientific Inc.*, in New Jersey, for example, 95 plaintiffs are suing 667 defendants for millions of dollars. In *Johnson v. E.I. du Pont de Nemours & Co.*, another New Jersey case, 22 plaintiffs have filed a class ac-

hearings, experts representing various groups testified about anticipated damages to the fishing industry, coastal recreation, and tourism. Jack Ravan, EPA assistant administrator for water, called for an entirely new research protocol because the ANPR received such severe criticism from both industrial and environmental groups.

At stage three, the proposed regulatory package reaches the desk of the top government policymaker. By this stage, most of the public comments in the

docket are virtually written in blood. Finally, after trying to accommodate as many of these requests as possible, the administrator establishes the agency's regulations. But once the new rules are published in the *Federal Register*, any of several entrenched groups may sue the agency for neglectful disobedience of their expressed needs in the public docket, and the vicious cycle continues in the courts.

This rule-making process has a long and distinguished career in the United States and probably



tion on behalf of some 80 homeowners who live near the well-known Price's landfill. In Harris County, Tex., 39 plaintiffs are pitted against 26 companies and allege that hundreds of thousands of people who live near certain dumpsites could also be plaintiffs. In *Anderson v. Crayovac* in Woburn, Mass., some 20 plaintiffs maintain

Local residents gather at Michigan's abandoned Swartz Creek dump. Gaining compensation for damages from such dumps is legally complex.

that wellwater pollution caused by three companies has led to cases of childhood leukemia.

Most of the pending suits

will never come to trial or judgment because the parties will settle out of court. Legal uncertainties make plaintiffs willing to settle for less than they might have received rather than risk dismissal of their case. Defendants—generally large firms—are not only afraid of large verdicts against their deep pockets. They also want to avoid establishing legal precedents that would make it easier for other victims to prove causation and joint liability.

In the only case that has gone to judgment, a New Jersey jury awarded about \$16 million in damages against the owners of the Jackson municipal landfill, from which toxic wastes had allegedly entered nearby residents' water supply.

In that case, *Ayers v. Township of Jackson*, 339 residents sued the township, alleging nuisance and improper and negligent conduct. The damages awarded were for impairment of quality of life, emotional distress, and the costs of medical surveillance for cancer. The New Jersey Supreme Court, on June 5, 1985, affirmed the judgment for \$5.6 million for impairment of quality of life, but did not allow the damages for emotional distress—barred in actions against

townships under the New Jersey Torts Claims Act—and for medical surveillance, considering these too speculative. Further appeals are likely.

Causation has emerged as a primary issue in injuries stemming from hazardous wastes. Although we know that exposure to certain kinds of toxic chemicals will cause health problems, proving the cause of personal injuries requires more than showing statistically that so much exposure will give rise to so many injuries. To recover damages against Jones Disposal Corp., Plaintiff Smith must show that his chloracne or cancer was caused, at least in part, by the particular toxic waste that Jones disposed of at a site. The mere fact that the Smiths live near the site is not enough unless they can show the path of exposure and a definite causal relationship between the exposure and the injury.

Another recurring issue in toxic-waste litigation is deciding which defendant is responsible. Toxic-waste sites often change hands frequently, and firms deposit a variety of chemical wastes in each site. Even if all possible defendants are made parties to the litigation, the plaintiff must show that each had

Continued on p. 50

represents the best overall approach in many situations. Yet the level of controversy tends to divert attention from establishing a comprehensive program for managing wastes.

For example, while high-temperature incineration of wastes is a step in the right direction, incineration at sea may be the wrong choice. Every time the EPA permits a new ocean-going incinerator to operate, it will severely delay efforts to reduce waste at the source, to recycle wastes regionally, and to incinerate

wastes near their site of generation. Nevertheless, now that the battle over ocean incineration has begun, all the interested parties feel impelled to pursue it to a final decision. Industry has already spent more than \$150 million to build ocean vessels for its test burns, while a single citizen group, the Gulf Coast Coalition for Public Health, spent \$50,000 in fiscal 1984 alone to fight these fleets. The stakes are simply too high for either group to back off. In many ways, toxic-waste rule making resembles a Chinese finger-

COMPENSATING TOXIC-WASTE VICTIMS

Continued from p. 49

some share in causing the illness before damages can be apportioned.

The obstacles are even greater when the illness has a long latency period. In the 20 or 30 years between exposure and illness, the plaintiff will have suffered other exposures, and the waste site will have changed ownership and uses, greatly increasing the difficulty of proving causation. In 12 states, moreover, the statute of limitations provides that the period when a lawsuit may be started begins to run at the time of exposure. In one jurisdiction with a three-year statute of limitations, plaintiffs who discover illnesses 25 years after exposure will have lost the right to sue 22 years before.

Hazardous-waste injuries, like other so-called toxic torts, require an array of medical, toxicological, and other sophisticated and expensive expert witnesses. The cost may be prohibitive unless the plaintiff is very wealthy or the potential damages are so large that an attorney is willing to work for a contingent fee. One solution is for several plaintiffs who have suffered injuries from the same source to join their lawsuits against the same responsible party, or for a large number of plaintiffs to bring a class action. However, the courts have been reluctant to allow class actions because even if all plaintiffs are exposed to the same disposal site, a 40-year-old professional will have dif-

ferent damages from a 23-year-old homemaker or a 5-year-old child. Even so, the number of such cases, whatever the joinder device used, will cast an enormous burden on the courts, with uncertain outcomes following lengthy delays.

No-Fault Compensation

Three years ago, the study group created under Section 301(e) of the Superfund legislation called for a no-fault compensation system giving victims compensation for medical expenses and for the full amount of their lost earnings, up to \$3,000 per month (amounting to the equivalent of \$36,000 per year before taxes). Under such a system, plaintiffs could claim compensation far more easily than in court actions, because proof of causation would be eased considerably. The plan would not provide for damages for pain and suffering or punitive damages. But plaintiffs who received awards could also bring full lawsuits—although they would have to reimburse the plan out of any damages they recovered.

The compensation plan would draw on an expanded Superfund, which now finances the cleanup of waste sites with money from a federal tax on crude oil and chemical feedstocks. The fund would recover some of the money it paid out by bringing its own suits against

the firms responsible for injuries from waste sites.

Congress has discussed the study group's recommendations for the last two years, and several bills have been introduced. Some incorporate the compensation remedy, while others create a new federal right to sue for toxic-waste injuries. Unlike other tort actions for nuisance, trespass, or negligence, which are brought in state courts, the new federal cause of action would apply only in the federal courts. Although hearings were held on some of the bills, no further legislative action is expected.

California and Minnesota have enacted laws for compensating the victims of toxic waste. However, the Minnesota law merely creates a new cause of action without easing the problem of proving causation. And while California has actually created a limited-compensation remedy, it applies only in cases where there is no available defendant. Though the statutes have been on the books for almost two years, no victims have brought cases under either.

Potential industrial defendants have opposed all proposals to make compensation easier to obtain. They argue that such proposals are premature because the courts can handle the few cases that have been brought under the ordinary rules of the common law of torts. Of course, these are the very defendants that have an interest in preserving

the difficulties of proving a toxic-waste claim.

Plaintiffs' lawyers do not object to setting up a compensation remedy for small claims—under \$50,000 or \$100,000—which they do not want to handle anyway. For the large claims, they see existing common-law court actions as providing the best chance to recover large damages, including punitive damages and those for pain and suffering. Of course, the lawyers would then be able to collect large contingent fees.

Insurance firms share industry's point of view, with one added concern: they believe that in the absence of claims experience for hazardous waste injuries they cannot set insurance premiums for an efficient compensation system. Apparently, both industry and insurers would accept a compensation remedy if the government were willing to pay out of general public funds—which is what the asbestos industry proposed after the Johns Mansville bankruptcy.

It seems that we will not provide a humane, economically sound, and prompt legal remedy for victims of exposure to toxic waste until the number of the cases reaches substantial proportions. That will happen soon enough. □

FRANK P. GRAD is Chamberlain Professor of Legislation and director of the Legislative Drafting Research Fund at Columbia Law School. Grad was a member of the study group on victim compensation established under Section 301(e) of the Superfund law, and he wrote the group's report.



The EPA could team up citizens and industries to select better ways of managing wastes.

box toy: the harder you attempt to pull your finger from its noose, the tighter the clamp becomes.

European rule making for toxic wastes differs from the U.S. model in important ways. Disagreements among interest groups are arbitrated rather than adjudicated, with the various groups openly discussing the options before the process of promulgating specific rules begins. Thus, both citizens and industry identify preferred managerial options before they have reason to disagree in public, and hence lessen the burden of proof placed on the federal government to defend its regulations. In contrast, the U.S. system forces polarization among experts called to testify for each side—especially concerning legal and technical outcomes and among the lawyers representing various groups. According to Sheila Jasanoff, an attorney doing research at Cornell University's Program in Science, Technology, and Society, U.S. law restricts the flexibility of the rule-making process by rigorously defining the governmental role and delineating agencies' decision-making functions.

Is it possible to adapt the European strategy to American needs? Establishing a formal process by which the EPA acts as an arbitrator before publishing its rules would be an important first step. This is the announced preference of the new EPA administrator. "When I was in the hazardous-waste program," Lee Thomas has said recently, "we talked about alternatives to litigation for Superfund cleanups—concepts like mediation and arbitration." The EPA has so far used these techniques, which attempt to secure government-industry memos of understanding without threats of bankruptcy or lawsuits, only with great reluctance. But Thomas has indicated that he plans to apply these strategies to other EPA efforts in an attempt to formalize the flow of information from all groups, and to prevent the possibility of sweetheart deals favoring one constituency. In particular, Thomas intends to employ European arbitration techniques to upgrade the standards for toxic-waste storage facilities, and to encourage construction of a new generation of treatment plants.

Critics of the EPA's regulatory process who feel that the agency already bargains over risks too often will undoubtedly oppose Thomas. For them, the EPA is debilitated by compromise, captured by special interests, and subjected to severe business pressures. To these critics, formalizing a means of compromise will only reinforce the existing system of producing

and dumping toxic wastes.

Yet EPA's predicament is far more complex than these critics acknowledge. The agency's many broad mandates impel it, in the face of recent cutbacks in funds and technical and legal staff, to design regulatory programs capable of "self-enforcement." These programs are designed to achieve broad compliance with a minimum of EPA-initiated suits and administrative actions. Toxic-waste programs developed by the Reagan administration are therefore diluted from the start, and this informal self-enforcement model has not been very effective. According to a recent report by the General Accounting Office, only 22 percent of the companies that manage America's most active hazardous-waste facilities comply with EPA regulations.

The EPA could restore public confidence by instituting a formal process whereby citizens and industries team up to select superior methods of managing waste. Citizens might well be willing to bargain over sites for recycling and treatment centers, with compensation for their communities, if they were assured that government and industry were unified in their efforts to phase out land disposal. Moreover, innovative industries that wish to reduce their liabilities from land disposal might agree to regulations requiring waste destruction and outlawing sloppy handlers.

The U.S. Search for Solutions

Several recent U.S. examples show the feasibility of adopting a European approach to managing toxic waste. Under Governor Jerry Brown, California initiated an aggressive program to phase out land disposal of cyanides, strong acids, PCB liquids, and all halogenated organics. A task force that included representatives from Dow Chemical, Friends of the Earth, and various academic institutions devised a schedule for this phaseout. California also provides low-interest loans for builders of integrated treatment centers through its Pollution Control Financing Authority. And the state has expanded the California Waste Exchange, a clearinghouse operated by the Department of Health that helps waste generators identify recycling opportunities.

Major firms such as Dow, 3M, and DuPont already treat some of their own waste on site. But many links must be forged to create a comprehensive waste-disposal system. Few firms have the capability

Toxic-waste extension agents could help firms comply with regulations.

of large chemical companies to process the poisons they produce, and even fewer local authorities know that treatment plants are practical or desirable.

The European example shows that utilities for treating waste must be set up to coordinate government requirements, regional needs, advanced technologies, and industrial skills in a public-private partnership. U.S. electric utilities, especially the Tennessee Valley Authority (TVA), according to Gary A. Davis, an attorney and chemical engineer, are American precedents for the types of agencies that can invest capital to fulfill public objectives.

Many producers of hazardous waste also have immediate needs for information about how to deal with it. Amendments passed last November considerably broaden the scope of the Resource Conservation and Recovery Act, closing a longstanding loophole that exempted small generators of hazardous materials from regulation. The EPA will now have jurisdiction over 795,000 more companies by 1986—including many gas stations, dry cleaners, textile industries, small paint and leather manufacturers, and electroplating shops. Yet these small firms will have trouble complying with the new law.

Their predicament is similar to that confronting farmers early this century. Agricultural techniques were clearly failing from overuse and inexpert soil management, but thousands of farmers lacked the information they needed to upgrade their equipment and improve the handling of their land. Congress responded by passing the Smith-Lever Act of 1914, which created the Agricultural Extension Program. The act linked the federal Department of Agriculture with state land-grant universities and county governments, and it put county extension agents into the field to educate farmers about new techniques.

A toxic-waste extension service could similarly help America's small and middle-sized generators. Extension agents could secure voluntary compliance with regulations and help companies avoid future liability from wastes. The service might first provide selected waste-handling firms—those with the most reliable equipment and best record—with information on how to set up a service to collect the newly regulated wastes from small generators. The European example shows that such collection partnerships are quite successful on a regional basis. The Danes, for instance, even collect household poisons, spent medicines, and old batteries at transfer stations in an all-out effort to keep hazardous materials from

entering their drinking water.

The extension program could serve as an arm of major universities, channeling the skills and research of faculty to the pressing needs of business. The list of clients for such information across the United States is growing, and includes major utilities, local and regional hospitals, and industrial parks.

A pilot hazardous-waste extension service is already under way at the Georgia Institute of Technology. A \$75,000, two-person operation in its first year, the service helps businesses employing up to 50 people to develop individual plans for handling toxic wastes. According to Kevin Kamperman, the staffer who makes on-site visits, the program helped "55 plants the first year, with over 400 barrels of wastes receiving proper analysis and thereby better treatment." The service, whose funding will rise above \$200,000 in its second year, is confidential, with no threat of EPA involvement. Moreover, compliance with the recommendations is voluntary.

This pilot program suggests that confidential consultation, custom services, and a process that enables the small firm to develop a capability to manage its own waste are important ingredients for success. There is no reason why we cannot set up similar programs across the country based on this experience. Such an effort would probably fare best if coordinated by the federal government, for without it the tragedy of land disposal will continue.

Of course, a toxic-waste extension service is merely a transitional device. The search for more pervasive solutions must continue. Waste reduction, recycling, and treatment are fundamental ideas whose time has come. Yet at a deeper level, they also are transitional. Ultimately Americans must revise their view of nature itself. America's 200-year-old myth of the unending resilience of its soils will die only with great difficulty, as this last decade of trauma over toxic wastes forcefully attests. Gaining a more robust understanding of nature's limited capacity to assimilate waste takes time, and a new view of humanity's place in the global commons.

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level department. Another is the military's continuing effort to break away from NASA and develop independent capabilities in space. These developments might or might not be good for the country, but they will surely not be good for NASA.

Doubling the Efficiency of Third World Stoves

In "Up in Smoke: Stove Programs Face Reality" (*February/March*, page 66), Duncan Brown misquotes me as saying that "even a good stove has a surprisingly small advantage in efficiency over a well-tended open flame: 17 or 18 percent compared with 13 or 14." In fact, I said that even a good *massive* stove (that is, made of mud or cement) has little advantage over a three-stone fire.

Working with the Voltaic Institute of Energy, Dr. Sam Baldwin performed high-power water-boiling tests on 13 different stoves, including the traditional three-

stone fire. Results show PHU (percent heat utilized, a measure of thermal efficiency) values ranging from 13 to 22 for ten different massive stove models. The three-stone fire showed a PHU value of 14.3.

In actual cooking, "specific consumption" tests revealed that one massive stove provided an average fuel saving of 9 percent over the three-stone fire, another 14 percent, but a third massive stove consumed 13 percent *more* fuel than the three-stone fire!

Tests of portable one-hole chimneyless stoves present quite a different story. A simple but improved metal stove achieved a PHU of 26.9—nearly double the 14.8 PHU of the traditional three-stone fire—while a ceramic stove more than doubled the PHU with 30.8. In actual cooking tests the metal stove, which can be sold for around \$2.50, achieved a 40 percent fuel savings over the three-stone fire.

The author mentions that promoters now generally favor an approach based on

more efficient "second-generation" stoves, but he leaves the impression that very little can be done to save fuel. In fact, stoves that cut fuel consumption almost in half actually exist.

John R. Lippert
Arlington, Va.

Mr. Lippert is manager of technical information at Volunteers in Technical Assistance.

In fairness to the author, the editors note that in his original manuscript, Duncan Brown did quote Mr. Lippert as saying that a "mud" stove was little more efficient than a three-stone fire. We cut the word "mud" because, at that point in the article, it was the only type of stove that had been discussed; we felt that repeating the adjective had become unnecessary. Brown did later talk about second-generation stoves and made clear that they represented a significant improvement in efficiency.

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Professor of physics, emeritus, Cornell University, and Nobel Laureate. Best known for his work on the hydrogen bomb, he also served on the President's Science Advisory Committee.



Morton Halperin

A political scientist and director of the Center for National Security Studies. He was a member of the National Security Council in the Nixon Administration.



George Ball

Undersecretary of state from 1961 to 1966. He has assumed many diplomatic and advisory roles on strategic and economic matters.



Rudolf Peierls

A physicist at Oxford University. He did early theoretical work on nuclear fission and led a team of British scientists who worked on the bomb at Los Alamos.

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*In an era of flexible manufacturing,
unions must exchange rigid traditions for new responsibilities
in managerial decisions.*

The Future of Automaking: What Role for Unions?

BY HARRY C. KATZ AND CHARLES F. SABEL

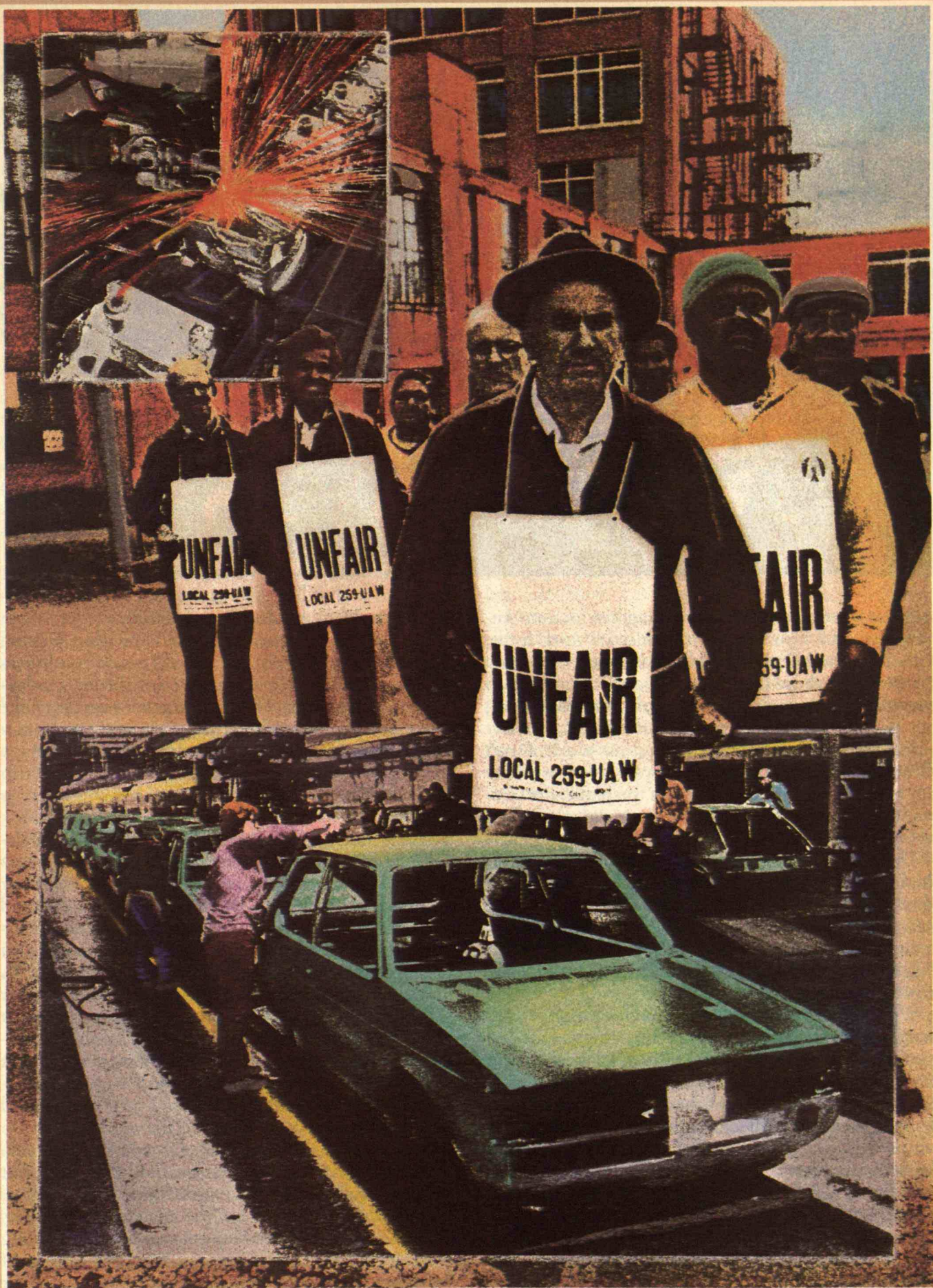
AUTOMAKERS and their unions are at a crossroads. To assure the industry's prosperity at home and abroad, Detroit must continually incorporate new technologies (notably new electronics and unconventional materials) into its vehicles and improve their quality. Automakers must at the same time increase their productivity and their ability to respond quickly to diverse and rapidly changing world markets. Thus, the U.S. industry has been experimenting with new production systems emphasizing flexibility.

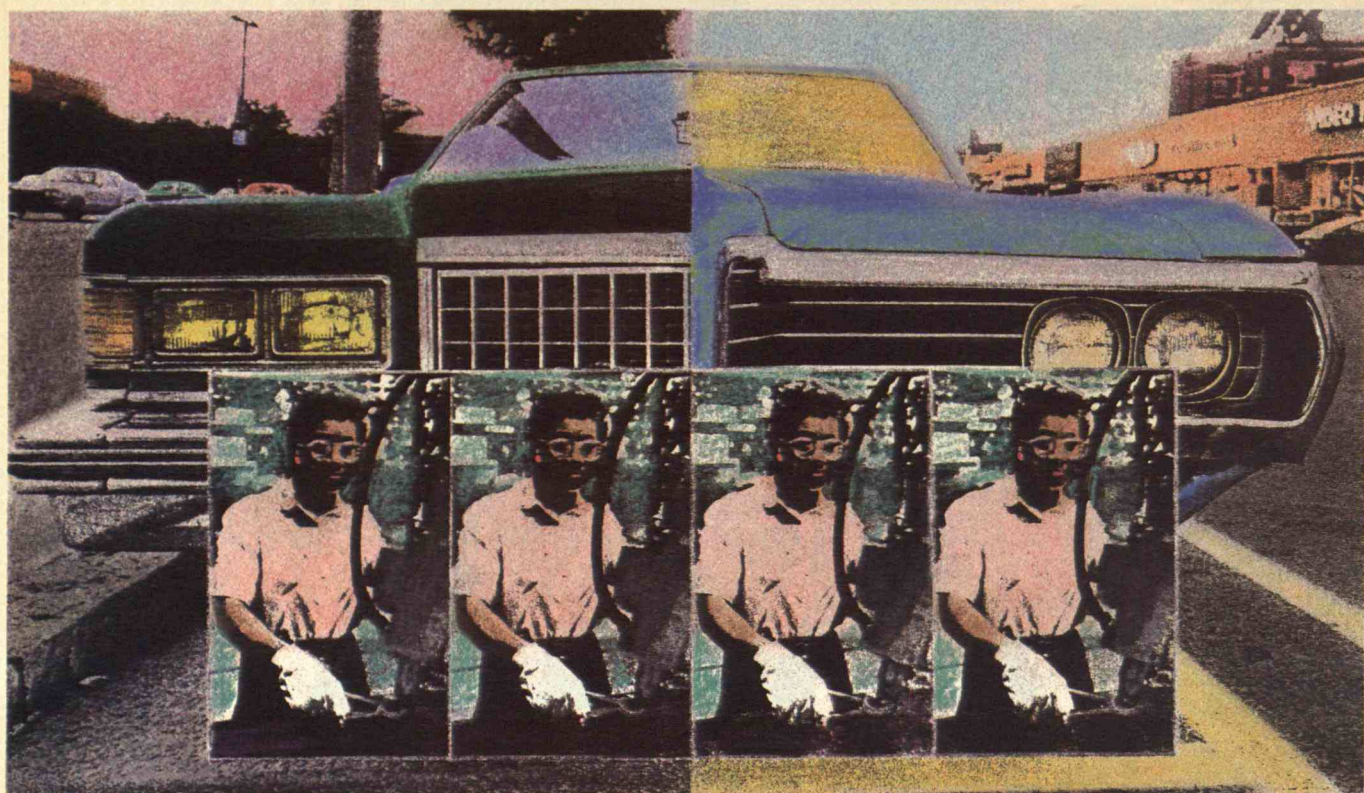
These systems undermine traditional labor-management relations. No longer can national unions guarantee industry-wide job descriptions and work rules; tasks will vary from plant to plant and even day to day. In the new era, national unions can instead participate in making basic business decisions, promote employment security, and give their members access to the diversity of skills they will need. Such approaches are suggested by the labor-relations practices of the most successful foreign automakers.

After World War II, two fundamentally different kinds of relationships between workers and manufacturers developed in the advanced capitalist countries. One kind—the U.S. system—was based on narrowly defined jobs arranged hierarchically to form career ladders. Auto assembly plants typically maintained over 100 job classifications—even including separate categories for left- and right-seat installers, for example. Mastery of one task prepared a worker for a more demanding, better-paying one. Workers ascended the job ladder according to their seniority, and layoffs when necessary occurred in reverse order of seniority.

Another kind of system—the one used in Germany and Japan—defined jobs more broadly and based pay on some combination of seniority and demonstrated skill. Promotion was competitive, but

ILLUSTRATIONS: STEPHEN ELSTON





workers were guaranteed something like lifetime employment: if a firm wanted to reduce its work force, it had either to find other jobs within the company for workers whose jobs were being terminated or to provide large monetary settlements. In the seventies, for instance, Volkswagen often provided large severance payments while reducing its work force. While the U.S. system made it easy to lay off workers but hard to redeploy them within the plant, the German-Japanese system made it easy to redeploy them but hard to lay them off.

The roles of unions reflected these differences. In the U.S. system, the national unions bargained with management to establish general wage levels, seniority rules, job classifications, and grievance procedures. Within each plant, union locals negotiated detailed job classifications and administered all the agreements legalistically.

West German unions bargained similarly with management at the industry level, setting wages and general work conditions—including rules to protect workers if management reorganized production. But national unions also established broad principles for resolving disputes. For example, these allowed workers at the local level to elect delegates to factory councils that could bargain with management over issues such as the introduction of new production machinery. Ideally, unions and management came to decisions in accordance with shared, equitable principles—the union acknowledging its responsibility to maintain productivity, management com-

mitting itself to employment stability.

The Japanese system was similar within a given plant. But wage levels and general work conditions were set company by company, not through industry-wide bargaining. National unions were more like loose political federations than institutions of collective bargaining.

A Revolution in Mass Production

These different union-management relationships developed in a single context: through the early seventies, all automakers based their manufacturing strategies on mass production. Consumer demand concentrated on a few car models that were fundamentally similar, though often cosmetically different. Markets for these models expanded steadily. Since manufacturers could depend on ever longer production runs, they could invest in increasingly efficient but inflexible machines, each capable of producing a single part or assembly. The process was self-reinforcing: more efficient machines led to reduced costs, and reduced costs led to lower retail prices, which further expanded the market.

Under such conditions, the U.S. and German-Japanese systems of labor relations had different, but roughly equivalent, advantages. Since technological change was incremental, the U.S. system, with its narrow job classifications, meant lower training costs. U.S. firms could also save money by laying off workers during economic downturns. On the other

*Stalemate: the companies focused
on maintaining mass production, the unions on
defending tangled work rules.*

hand, since the market was expanding, Japanese and German firms could honor employment guarantees inexpensively while enjoying the flexibility to move workers easily from one job to another. Only the economic troubles of the seventies revealed how important the differences between the systems actually were.

Two developments in the early seventies led to fundamental changes in the auto industry. First, the automobile markets in the advanced industrial nations started to become saturated. Automakers had traditionally concentrated on markets in their own countries, but now expansion hinged on penetrating markets in other countries, and competitive pressures mounted. Second, the oil shocks of 1973 and 1979 created a demand for fuel-efficient vehicles.

U.S. producers failed to understand the long-term implications of these developments. They assumed that the rise in fuel prices required only a one-time redesign of existing lines. Then, to solve the problem of increasing international competition, U.S. automakers turned to the "world car" concept, trying to create a vehicle for a global market. They sought to locate plants to produce components wherever labor was cheap, and to assemble identical cars in many countries. In short, the industry aimed to extend the principles of mass production—standardized products, subdivided labor, and dedicated machines—to a world scale. Ford's Escort epitomized this strategy.

However, markets did not stabilize, and it turned out that no single design could be successful worldwide. As oil prices softened, U.S. consumers again began to demand large cars, for which the overseas market was small. Breakthroughs in microelectronics and materials made it impossible to freeze a standard design, as did fuel efficiency and pollution control laws that varied over time and among countries.

Furthermore, the decentralized production strategy for the world car turned out to have hidden costs. There were quality-control problems, and the threat of supply disruptions from widespread suppliers required extensive and costly inventories. Foreign exchange rates fluctuated, upsetting profit margins, and labor militance at the new manufacturing sites jeopardized the system.

Two alternatives to the U.S. mass-production strategy proved more suited to the new conditions. One, associated largely with Japan, began as a variant of mass production. Suppliers were located near

the final assembly plants so they could produce parts and sub-assemblies in small lots as needed, each labeled with a *kanban*, or tag. This *kanban* plan reduced inventory costs and allowed defects to be spotted and corrected promptly. Furthermore, production workers in final assembly operations were grouped into "quality circles." Such workers were expected not only to perform assembly tasks but to uncover manufacturing problems and devise ways of altering production to solve them.

A second strategy, specialization, shifted competition from a product's price to its characteristics. Instead of aiming to make variations on a standard vehicle to satisfy different price and luxury requirements, manufacturers sought to produce specialized vehicles that met the needs of particular consumers. In the German industry, for example, Mercedes and BMW produced semi-custom vehicles for demanding customers.

In many ways, the two alternative strategies turned out to have similar effects. Toyota perfected the specialization strategy in the fifties, and then massively increased production (and productivity) in the late sixties. Nissan, which started by perfecting the mass-production strategy, learned from Toyota, the specialization expert, to use machinery and workers flexibly and produce models cost-effectively in low volumes.

The search for flexibility underlying both these strategies has led the world auto industry to turn the principles of mass production upside down. The trend is away from producing a standard car with specialized resources—using workers with narrowly defined jobs and dedicated machines. Instead, automakers are learning to produce specialized cars with general-purpose resources—broadly skilled workers and machinery that can be reprogrammed or adapted to make various models.

While it is impossible to say how malleable production will become overall, most automakers now agree that flexible deployment of labor—and hence the German-Japanese system of labor relations—will be crucial. Workers need an expanding range of skills.

But workers are unlikely to invest in acquiring these many skills unless they can count on continued employment that depends on those skills. Furthermore, they will not accept the necessary broad job classifications and informal work rules without guarantees that management will not abuse its new free-

*In its search for flexibility,
the world auto industry has turned the principles
of mass production upside down.*

dom. Such guarantees might take the form of worker representation on a factory council of the sort that exists in West Germany. The council would have the right to review daily decisions and negotiate major reorganizations with management.

No automakers found it easy to adjust to the changed environment of the seventies, but as the following sketches show, those with flexible industrial relations encountered less difficulty. Those with rigid labor-management relations are still hard-pressed to find ways of overcoming that rigidity.

West Germany: Jobs in "Islands"

During the sixties, much of the German automobile industry moved toward the U.S. mass-production strategy. The formation of the European Common Market in 1957 had created the broad market this strategy required, and German manufacturers hired increasing numbers of immigrant workers from Turkey and Southern Europe to fill the narrowly defined jobs, for which little training was necessary. However, the German industry's traditions of collective bargaining persisted. When management created disputes by transferring workers from one job to another, elaborate work rules and grievance procedures did not settle the matter for everyone at once, as in the United States. Rather, the local factory council negotiated with management over each case. In fact, while the Social Democrats were in office in the late sixties and early seventies, a series of labor laws and bargaining agreements strengthened the local factory councils, most of which remained under the control of skilled German workers.

During the disruptions of the seventies, the factory councils prevented manufacturers from laying off domestic workers and adopting the U.S. world-car strategy. Manufacturers found that they could reduce their employment levels only by using severance payments to encourage voluntary terminations. Because so many German workers kept their jobs, overall skill levels rose. And even during the sixties, some German auto producers such as BMW and Mercedes had continued the tradition of specialized production. For these reasons, German producers easily shifted toward a strategy of flexible production.

A clear sign of this shift was the reform of the job classification system at Volkswagen in 1980. Though VW had previously followed the U.S. principles of setting wages according to detailed job descriptions,

it replaced this system with one grouping workers with related jobs into broad "islands," or teams, typically formed around work areas. For example, such a team of perhaps 10 workers might assemble an axle component. Transfers among jobs in the same team no longer required even *pro forma* review by the factory council. And even boundaries of the islands could be redefined if conditions changed.

A study by two leading German sociologists, Horst Kern and Michael Schumann, shows that a number of German plants have successfully created teams with members who act as both semiskilled machine attendants and more general craft workers. Cooperating with skilled maintenance workers, operators of autobody welding lines can correct many mechanical and some electrical faults themselves.

The United States: State of Flux

Reform of industrial relations in the United States faced two difficulties. First, there was the producers' uncertainty about overall strategy. For a long time, firms were less interested in increasing flexibility than in maintaining mass production. Their strategies included increasing the work pace, cutting costs through automation, and locating factories in low-wage areas. Second, once firms finally began to strive wholeheartedly for flexibility, they encountered unions committed to defending a tangle of work rules. In practice, the rules seldom were applied as written; the unions typically relaxed or modified them in return for concessions from management. But such bargaining was difficult and costly. As the pressure for flexibility increased, management became more determined to change the rules, and labor tended to see this determination as an attack on its rights.

General Motors' experiments with reorganizing work during the seventies illustrate these tensions. Sometimes the company studiously avoided attempts to change relations with unions. For example, in the early seventies, GM and the United Auto Workers (UAW) agreed to a "quality of working life" (QWL) program. Under this plan, production workers could discuss problems with supervisors and suggest solutions, but the discussions were to take as given all matters covered by collective bargaining, including job classifications.

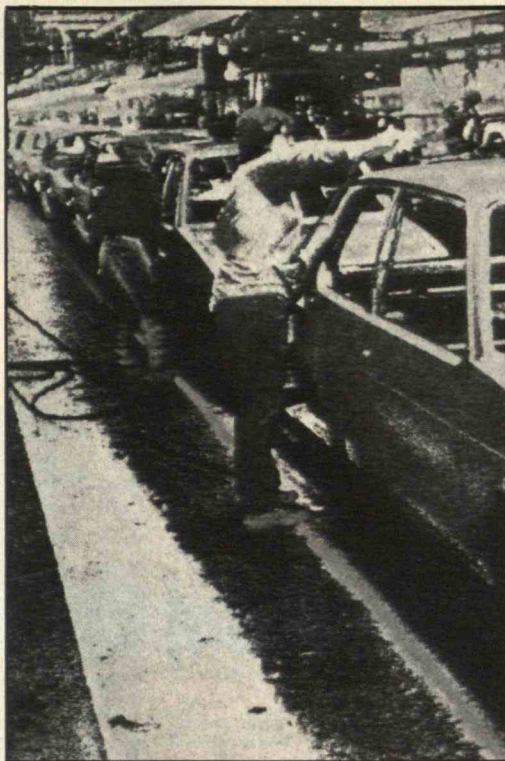
In other experiments, GM sought to eliminate the role of unions completely. In the mid-seventies, the

company introduced broad job classifications in a number of non-union plants opening in the South. The goal was to increase flexibility—and also to facilitate communication between workers and supervisors, reduce tensions on the shop floor, and thus diminish the appeal of unions.

After a sales slump between 1980 and 1982 shook GM's sense of invulnerability, the company made a serious effort to redesign jobs. However, it also sought pay reductions. At the Packard Electric plant in Warren, Ohio, the company proposed that quality circles and work teams take responsibility for an entire job, reducing the number of job classifications. But the company also wanted to bring in new employees at a third of the existing wage rate. The union's predictable resistance to wage cutting also impeded GM's efforts at job redesign.

Even when companies did not try to cut wages, their efforts to redesign jobs met with mixed success at best. In the early eighties, GM tried to introduce operating teams with 10 to 15 workers in a common job classification. The experiment centered on a number of new Northern plants, including the Cadillac engine plant in Livonia, Mich., and the Cadillac assembly plant in Lake Orion, Mich. In negotiating Lake Orion's first local contract, skilled machinery-repair and maintenance workers opposed and slowed these job redesigns, which they feared would threaten their own positions. At the Livonia plant, management did form operating teams, but only after skilled workers had been voted down in a plant-wide referendum to block the use of teams.

By 1984, GM realized that no refinement of mass-production techniques could assure its ability to be competitive in making small cars. At the same time, the company saw that its profits were coming increasingly from specialty vehicles—recreation vehicles, sports cars like the Corvette and Fiero, and luxury cars such as Cadillacs. As a result, GM began to develop more focused strategies for flexible production, in which reformed labor relations played an integral part. This changing attitude is evident in a 1984 settlement at the Packard Electric plant,



where GM and the International Union of Electrical Workers agreed to reduce the pay of new employees, guarantee all workers lifetime employment, and broaden job classifications.

The Saturn project to build a radically new small car is a more dramatic indication of GM's reorientation. The car will be assembled in modules by teams of broadly skilled workers. A new division (the first since Chevrolet in 1918) will manage the project, and a separate agreement between the company and the UAW will govern labor relations. The UAW Executive Board recently approved

a labor agreement that includes union and worker involvement in Saturn business decisions, team work-units, a salaried pay system for all blue-collar workers, and wage levels linked to Saturn's financial performance.

Nevertheless, the future of industrial relations at GM is by no means resolved. Saturn is officially described as an experiment. And the Saturn division's autonomy is probably designed to insulate the rest of the corporation from change as much as to protect the new initiatives from the crushing weight of habit.

A new model of industrial relations must accommodate broader job classifications, new job security, pay guarantees, and training programs—a redefinition of the union's role in protecting workers' interests. Otherwise, piecemeal reforms will continue to be hostage to economic events. Ill fortune—perhaps continued high values of the dollar overseas, or increasing sales of foreign cars in the United States—could move GM to sacrifice long-term reform for short-term cost reductions.

Italy: Unions Defeated

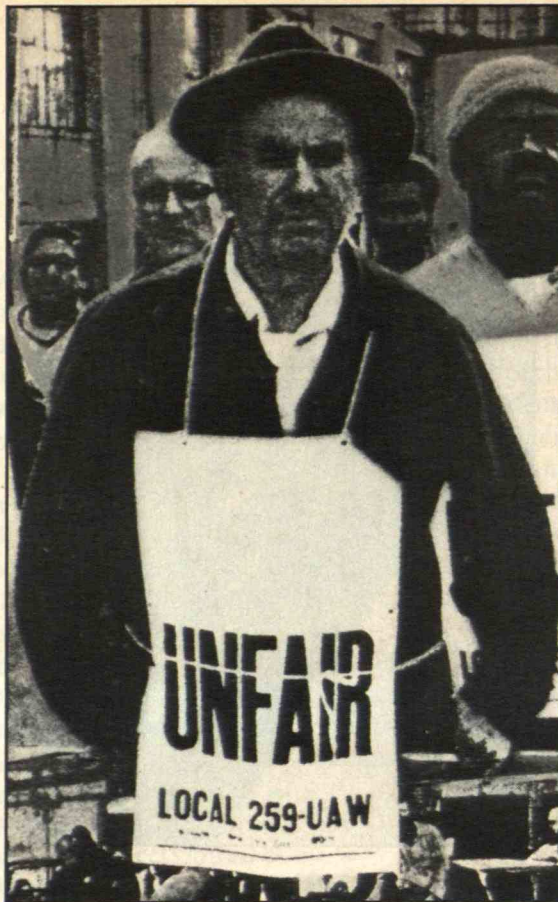
Italy demonstrates even more dramatically than West Germany the ease with which the U.S. model of mass production can be modified. The difference is that for the Italians, modification has been a much more painful process. The Italians expanded mass-production lines rapidly during the sixties with a

system that appeared similar to the German one. By the seventies, the Italian unions had claimed extensive authority. In some firms, such as Fiat, the factory council elected by union members to bargain with management was strong enough to prohibit layoffs and control transfers of workers to other jobs. It could even stipulate the speed of production lines. A large wall poster in each unit kept the council-approved output rate constantly before all eyes.

Largely because of their power, the unions did not think it necessary to institute the narrow job classifications and detailed seniority rules characteristic of the U.S. system. In fact, during the seventies, labor's commitment to socialist principles led to further simplification of job categories and experiments in job redesign. These developments foreshadowed programs for work teams.

But the lack of work rules made unions vulnerable: if they once lost the ability to impose their will unilaterally, they would be powerless. This is what happened at Fiat in the early eighties. The union was blinded by past successes, and despite the recession and declining markets, the factory councils intransigently refused to reduce employment levels or increase production rates. The resulting decline in productivity was potentially ruinous, and Fiat rallied not only the public but the workers themselves to oppose the factory councils.

The unions' defeat has provided the setting for a flexible reorganization that has revived the firm. For example, Fiat has developed an extremely versatile "robogate" system for automated welding, and Comau, the company's machine-tool subsidiary, has also produced a flexible engine transfer line capable of making a variety of engine types. Indeed, one of Comau's flexible transfer lines was the first of its kind to be installed in the United States. Fiat also uses work teams effectively, and its reorganization of repair work served as the model for British Leyland's efforts to revise its craft practices (although British Leyland's reforms largely failed).



However, Italy's virtual suppression of unions does not bode well for the future of labor relations. It may be that management's current triumphs will prove as fragile as the unions' of the recent past.

A New Kind of National Union?

Whether they help or hinder adjustment to the new competitive conditions, national labor organizations are threatened by the current changes. This is true even in West Germany. There the national labor movement responded to the slow economic growth and

high unemployment of the seventies by calling for a traditional Keynesian program: government spending was to increase and the money supply was to expand, stimulating demand and creating jobs. The goal was to stabilize the faltering mass-production economy. To reduce or mitigate unemployment, the unions also called for shortened work weeks, compensation for displaced workers, and expanded vocational training.

It was only at the plant level that unions had forward-looking responses to the new economic conditions. Factory councils negotiated for job security, letting management organize production flexibly and respond to fluctuating demand. Thus, local industrial relations came increasingly into conflict with the national unions' more traditional efforts.

The less successful national unions seemed to be, the more they seemed tempted to reassert control over local councils by instigating conflicts with management. For example, in the 1984 strike by IG Metall, pitting the metalworkers against the automobile industry, the national union demanded a sharp reduction in work hours. This strike helped to concentrate attention on the traditional idea of sharing work through shorter hours, just when labor needed to consider its possible role in coordinating local innovations. Though IG Metall emerged from the conflict unified and partially victorious, it still had no coherent program for the future.

*When a union is vulnerable,
each level is likely to see almost any effort
at reform as a power play.*

Because of the way U.S. unions are structured, tendencies toward local diversity pose even more serious threats. The national organization sets general wage levels and assures that local job classifications and work rules conform to uniform standards. Local shop stewards and national staff are demonstrably indispensable because they arbitrate grievances by interpreting these rules and classifications. However, integrating jobs in the plant allows workers to settle disputes informally. This makes it harder for unions to justify themselves as daily guarantors of workers' rights. And the national unions' importance is further eroded because the economic environment makes it virtually impossible to negotiate substantial wage increases at the industry level.

Because unions are so vulnerable, each level of a union is likely to see almost any effort at reform as a power play by some other level of that union. Consider a recent episode among the Communications Workers of America (CWA). As part of a general reconsideration of its strategy, the CWA appointed a Committee on the Future in 1981. One of the committee's recommendations was to "seek new approaches to grievance handling with employers who are serious about reducing the grievance load through joint problem solving." But at a union convention in 1983, local representatives apparently saw this proposal as a threat to the shop stewards' ability to administer the grievance procedure. "Let us deliver a message to our leadership," one typically angry delegate said, "and let them know, yes, we want to resolve our problems, but do not mess with the most important part of our job, which is the grievance procedure." After a long debate, the convention recommended only that the CWA "explore with caution possible new approaches to conflict avoidance." The committee's other reform proposals fared no better.

On the other hand, suppose reform begins not at the national level but from below, in spontaneous collaboration between hard-pressed managers and locals. Any success will provide a model that can be applied elsewhere in the industry, but such a model is likely to provoke attack by various groups in the national union. Concerned only with defending the organization, some moderate officials will see local innovations as breaches of contract and challenges to authority. Militants will see local cooperation as a step toward company unionism—that is, as a de-

cluded denial of the fundamental antagonism between labor and capital. Both groups will see promising local experiments as the spawning ground of rivals whose edge would be an intimate knowledge of current conditions.

Locals of the International Association of Machinists (IAM) recently signed two agreements that show how plant-level collaboration can threaten a national union. In 1983, the Seattle local and Boeing agreed to reduce cost-of-living adjustments, cut pay for new employees, broaden skill classifications, and continue quality circles. The national union saw in this an assault on its right to set industry-wide standards and a threat to the grievance system. Opposition was all the more vehement because the Boeing settlement traditionally had set the pattern for bargaining in the aerospace industry.

The second disruptive agreement was one with Eastern Airlines in 1983. Here the local made extensive wage concessions in return for representation on the company's board of directors, a share in the firm's equity, and far-ranging rights to participate in shop-floor management of maintenance operations. Unlike the Boeing agreement, this settlement could not be dismissed as collusion with capital. But without a plan for linking local agreements to industry-wide reform, the national leadership could not endorse the Eastern contract, either. The national's strategy was to stall negotiations—and sometimes to sabotage local reform efforts.

But reform of American industrial relations is not impossible. There are signs that some major American unions are successfully making changes already. The clearest example is a 1984 UAW agreement with GM and Ford that creates the possibility of long-term job guarantees while allowing management to organize work flexibly. The agreement creates "job banks": if a company lays off workers in one factory because of technological change or outside purchases of parts, the company must retrain these workers and employ them elsewhere. Failing that, it must provide full income replacement. Furthermore, local, regional, and national labor-management committees are given authority to "waive, modify, or change national agreement provisions when such action would result in the preservation or increase of job opportunities."

In effect, management and labor jointly decide how to match workers to jobs. Were this agreement

Continued on page 79

*Astronomers are
using technology and politics
to dim troublesome
city lights.*

Blinded by the Light

BY NORMAN SPERLING

YOU'VE been hearing about Halley's comet all your life, and you probably know it's just about here. Your grandchildren will ask you what the comet looked like back in 1986. But despite all the excitement, it's going to be enormously disappointing for most people who try to see it. Astronomical conditions will probably make the comet considerably fainter than it appeared during its last pass, in 1910, and it will hover close to the murk of the horizon. But the biggest problem is that artificial illumination carelessly splattered around the sky—light pollution—will make the comet unfindable from cities and unimpressive from suburbs.

Since everyone wants to see Halley's comet, this will essentially be the first time that the general public will discover what astronomers have long known: light pollution ruins the view of the cosmos. Stray light fogs photographic plates, contaminates measurements of brightness, and distorts spectrograms that reveal details about the chemistry and physics of celestial objects. Halley's comet will be visible only to those who evade light pollution or eliminate it. Evasion means escaping to the boondocks while elimination would require entire metropolitan areas to enforce blackouts.

Since the turn of the century urban astronomers have noticed that, when the last glow of dusk disappears, the sky fails to darken completely. "In the immediate vicinity of the city this reflection is so intense that even the brighter stars become invis-



This composite photo, taken at midnight by a satellite 450 miles up, illustrates just how much light U.S. cities splatter into the skies. The lost light not only makes life difficult for astronomers; it wastes electricity and dollars.

*For urbanites—
most of us—the night sky is now a
murky blue or gray, not a black
cloth set with jewels.*

ible to the eye, while faint celestial objects cannot be observed at all," astronomy author Gideon Riegler noted in 1910. "Even at great distances, up to 30 or 40 miles, this glare makes itself noticeable." A dozen years later, astronomer George Ellery Hale offered this advice to novice skywatchers: "Go out under the open sky, on a clear and moonless night, and try to count the stars. If your station lies well beyond the glare of cities, which is often strong enough to conceal all but the brighter objects, you will find the task a difficult one."

New observatories were therefore established away from cities, in locations where the air is clear, dry, and steady—typically mountaintops. But still the lights encroached. By World War II the growing sprawl of Los Angeles seriously compromised the effectiveness of the world's greatest telescope, the 100-inch reflector atop Mount Wilson. Today the sky over Mount Wilson is more than six times brighter than an unpolluted sky. That is why its operator, the Carnegie Institution of Washington, has closed the telescope this year. The astronomical community is trying to find a new sponsor for the telescope, since some useful kinds of observing can still be conducted there. But light pollution, rather than age, is Mount Wilson's biggest problem.

Such pollution also threatens to chase other important observatories—major national research centers—from their mountaintops, as it chased them from our cities decades ago. However, some communities are adopting new kinds of street lighting to try to keep astronomers in business.

Technology Gains, but So Do Lights

The issue of light pollution was introduced to non-astronomers in the March 30, 1973, issue of *Science* magazine. Kurt Riegler, then a UCLA astronomer, wrote, "If total outdoor lighting continues to grow at a rate of only 10 percent per year, by 1985 the national light level will have increased by a factor of 300 percent." Riegler, now head of the National Science Foundation's Astronomy Centers section, declared in July that his "prediction has in fact been borne out." Other astronomers have expressed similar worries. "If the growth rate of outdoor lighting in this country over the last two decades continues through the next two," Arthur Upgren, of Wesleyan University's Van Vleck

Observatory, said in 1981, "it will account for over half of all electrical power usage, and the night sky will be over 40 times as bright as it is today. Our larger cities will be visible to a naked-eye observer standing on the moon."

The problem is not simply the growth in outdoor lighting. It also stems from the wasteful pattern of illumination from each lighting fixture, careless placement of those fixtures, and changes in the types of lamps used. Look at the streetlights around you tonight: not only do they pour light onto the ground beneath them; they also spray surprising amounts of light sideways. Streetlights far down the road look so bright not because they illuminate their own areas, but because they glare directly at you. Since this "sideways" light is too dim to aid vision by the time it reaches the ground, it is sheer waste. Some streetlight fixtures, including the common "cobra-head" style, actually emit light above the horizontal. This light never reaches the ground at all but illuminates the sky instead.

Astronomers, of course, are masters at extracting maximum information from a minimum amount of incoming light, and their techniques for measuring distant sources of light are improving. David Burstein, an astronomer at Arizona State University, has traced the efficiency of astronomers' light detectors. Photographic plates, used since the 1870s, register perhaps 3 percent of the photons that hit them. Photomultiplier tubes, developed in the 1940s, operate at about 20 percent efficiency in collecting photons. The silicon-diode arrays of the 1970s doubled this. And the latest high-tech wrinkle, electronic detectors called charge-coupled devices, register more than 65 percent of the photons striking them.

Astronomers can tolerate outdoor lamps that emit their light in only a few specific spectral lines. Low-pressure sodium light (which looks golden yellow to the eye) blocks just 1 percent of the spectrum, and bluish mercury-vapor light blocks about 3 percent. The emission spectra of these lights are like picket fences, and astronomers have learned to peek between the pickets. Computer programs that monitor electronic imaging devices ignore the sodium and mercury spectral lines, effectively evading that pollution.

However, this technique does not work for "continuous-spectrum" lamps, which smother all spectral information from

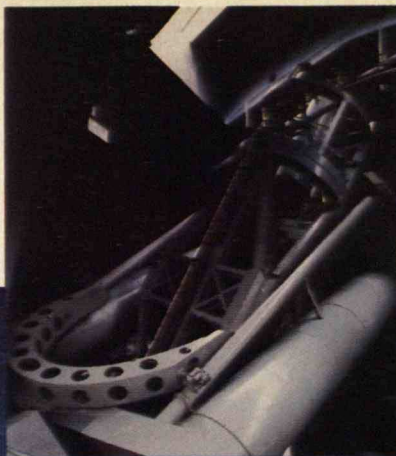
faint cosmic objects. These include ordinary incandescent lights and fluorescent lights. Pinkish high-pressure sodium lights wall off about 42 percent of the spectrum. Thus, astronomers use another technique to evade light pollution across the spectrum: they point the telescope alternately at the object of interest and at a neighboring patch of sky. A computer subtracts the pattern of light seen in the nearby patch (which includes any light pollution) from the object's total, leaving only the spectrum of the desired source. Astronomers can use this technique to detect signals as weak as 1 percent of the light pollution, but dimmer objects such as the remotest galaxies are still lost.

Not all astronomical observing is done by professionals with expensive, high-technology instruments; many volunteer observers also perform an enormous amount of valuable scientific work. These people typically use telescopes they make or buy themselves, and pursue extensive monitoring programs that professionals cannot spare the time for. The volunteers monitor the flickerings of variable stars, the vagaries of weather on distant planets, and the rates of meteor showers. They patrol for new comets and the flarings of dying stars. Such volunteers often conduct celestial surveillance with a breadth and continuity that professionals cannot match. And then there are the hundreds of thousands of people who view the heavens simply for recreation.

These skywatchers often turn to special filters, mounted at the telescope's eyepiece, to cope with light pollution. The filters work by "destructive interference." They consist of several layers, each one-fourth as thick as the wavelength of the light it is designed to block, which double the rays back on themselves. The troublesome rays thus cancel themselves out, while other wavelengths of light pass through. However, these filters work well only for observing a few kinds of objects such as certain hot, thin gas clouds. Most celestial objects suffer badly even through pollution-rejection filters.

Lights and Laws

Astronomers are learning to cope politically as well as technologically with light pollution, and in a few critical regions they have lobbied successfully for laws restricting outdoor illumination. Windsor Township in Berks County, Pa., has perhaps the



San Diego's night glow has steadily encroached on Palomar Mountain, home of the nation's largest optical telescope (inset). However, the city has agreed to switch to streetlights that astronomers can better tolerate.

simplest ordinance: "Lamps used to illuminate ground areas shall be hooded or so shielded that light shines downward. Structures or buildings shall not be illuminated by directing light upward from the ground, but may be illuminated by mounting lamps along the top edge of the wall with such lamps hooded so as to shine downward." The ordinance protects Pulpit Rock Observatory, one of the largest and most successful volunteer-observer stations in the East. Villanova University astronomers furnish electronics for the 22-inch telescope built and staffed by members of the Lehigh Valley Amateur Astronomical Society.

Palomar Mountain, home of the world's largest productive optical telescope, re-

cently gained at least some protection from the threat of increasing light pollution from San Diego—but not without a considerable fight. Light pollution had become so severe that the effectiveness of the 200-inch reflector had decreased to that of a 140-inch instrument for some observations. So astronomers asked San Diego to convert its street lights to relatively unpolluting low-pressure sodium lamps. They argued that the switch would immediately lower the sky glow by 60 percent and keep light pollution at tolerable levels for the rest of the century.

The astronomers also touted potential economic benefits: the increased energy efficiency of low-pressure sodium lamps could save the city millions of dollars per

year. But some critics argued that the lights were ugly—"bug lights," city councillor Bill Mitchell called them—and that other measures, such as proper shielding, would protect the observatory. Early last year the astronomers, and economics, finally won. Robert Brucato, assistant director of the observatory, called this "a major step in allowing Palomar to continue to do forefront astronomy." In gratitude, a Palomar astronomer named a recently discovered asteroid "San Diego."

Even worse light pollution afflicts Lick Observatory, located atop Mount Hamilton and within sight of San Jose, the booming capital of California's Silicon Valley. Lick astronomers are winning converts to low-pressure sodium lights with

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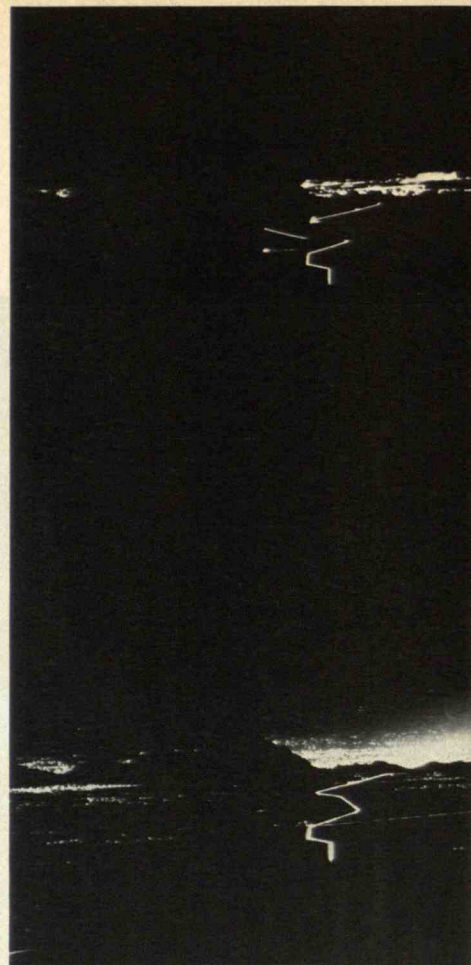
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less contention than their Palomar colleagues. Sandra Faber, who normally spends her time observing faint, distant galaxies, has devoted much of the last six years to this effort. She has helped convince the city to change its street lights to low-pressure sodium. San Jose recently broadened its policy to require all commercial and industrial parking lots to use them.

However, the biggest effort has occurred in Arizona. Kitt Peak National Observatory, located near Tucson, mounts the world's largest collection of astronomical instruments. Other observatories also perch atop Mt. Lemmon and Mt. Hopkins near the desert city. City and county ordinances controlling outdoor lighting are now in force across the entire south-central part of the state, and they have fought stray light to a standstill despite the region's mushrooming population.

"The problem is almost always awareness, rather than resistance," says Kitt Peak astronomer David L. Crawford. "Most people are pro-astronomy, especially when it doesn't cost them anything." Crawford explains to city officials and at public meetings how San Jose converted 31,963 street lights to low-pressure sodium. Data from San Jose's associate civil engineer, Michael Sartor, show monthly savings of nearly 1.6 million kilowatt



The lights of Tucson in 1959 (top) and 1980 (below), as seen from Kitt Peak National Observatory. Fortunately, city and county ordinances controlling outdoor lighting have fought stray light to a standstill despite the region's booming population.

hours of electricity. The city's monthly bills have already decreased by more than \$23,000. And when the conversion costs have been paid off in 5 years, the city will save about \$138,000 every month.

Crawford has chaired the American Astronomical Society's Light Pollution Committee for several years, which led him to actively participate in the Illumination Engineering Society's Light Trespass Committee in the early 1980s. By 1984 the inevitable had happened: the committee's most vigorously involved member was asked to chair it—so Crawford now heads the lighting engineers' efforts as well as those of the astronomers. This gives astronomers better communication with lighting professionals. "The Illumination Engineering Society has issued a 'statement of concern' about light pollution," says Crawford, adding that he expects the society to take even further action. "As individuals and organizations, they will be looking after light-pollution concerns using low-pressure sodium and shielding, and manufacturers are working on improved lamps and fixtures."

Aesthetic Drawbacks

Critics still raise occasional objections to low-pressure sodium lights, especially aesthetic concerns. Even Carl Sagan, perhaps

astronomy's best-known advocate, acknowledges that "complexions appear a bit sallow" under the yellow lamps. However, proponents cite several recent public-opinion surveys suggesting that people will accept the lights. For example, a telephone poll conducted by researchers at San Diego State University found that an "overwhelming majority" of San Diegans either did not mind the lights or were willing to accept them for the benefit to Palomar Observatory.

Another limitation, at least for the moment, is that no U.S. companies make the low-pressure sodium lamps. They are now imported by Philips, the Dutch electrical conglomerate, from European factories under the trade name Norelco. However, several U.S. companies have expressed interest and are awaiting increased demand.

Of course, there is clear and rational value to well-planned outdoor lighting, and no astronomer advocates the blackening of cities. But some lights are simply not needed. For example, California's Department of Transportation removed about 8,500 freeway fixtures—about 15 percent of its statewide total—in 1975 to save energy. The department, which sought help from the Highway Patrol in deciding which fixtures to remove, found no noticeable increase in accidents and received scarcely any public complaints.

Indeed, the most straightforward resolution may involve low technology rather than high—hood fixtures that not only prevent light from heading skyward but also reflect the light selectively to zones where it is most needed. Properly engineered for simple installation and low maintenance, inexpensive metal stampings could reduce both light pollution and hazardous glare on roadways. By improving illumination, they could permit the use of lower-power lamps that cost less and last longer.

The resulting darkening of the night sky would be truly dramatic. The pure beauty of the star-filled sky fulfills an overwhelming aesthetic imperative. This sight is presently denied urbanites—most of us. At best, people can spot only a few of the brightest stars, an occasional planet, the moon, and the sun. Our sky is a murky yellow or blue or gray, not a black cloth set with jewels. City dwellers have beaten the day-night cycle into submission at the cost of a perspective known to all previous generations: the immediacy and grandeur of the cosmos around them.

NORMAN SPERLING teaches astronomy at California State University at Hayward and lectures at Morrison Planetarium in San Francisco. He also designs and develops astronomical products and facilities.

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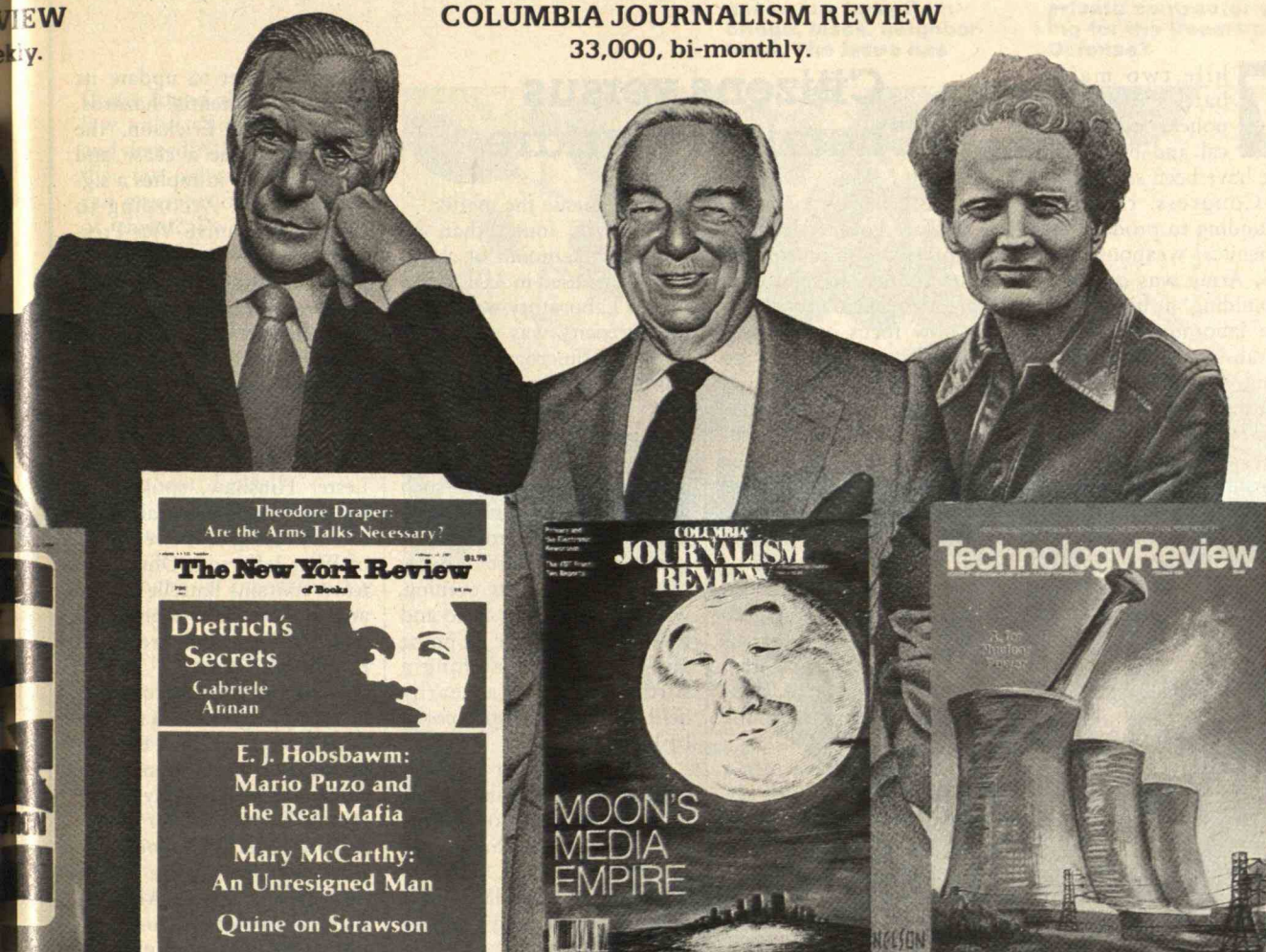
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While two major battles over U.S. policies on chemical and biological warfare have been settled for now—Congress recently voted funding to produce binary chemical weapons, and the U.S. Army was enjoined from building a biological-warfare laboratory in Dugway, Utah—new controversy is stirring. Across the country R&D firms are building labs to compete for new defense contracts on chemical warfare. Neighbors of some of these facilities object that research on nerve agents should be done only on isolated bases.

The situation stems largely from the growth of the federal budget for research on chemical warfare. At \$400 million in fiscal 1985, it had almost quintupled since 1981. According to army spokesman James Allingham, personal equipment in Soviet tanks captured by Israel in the 1973 Yom Kippur War with Egypt first alerted the U.S. defense community to the Soviet ability to fight a chemical war—and to the conclusion that U.S. chemical forces were lagging behind. "We're trying to overcome a longstanding insufficiency in chemical equipment," says army spokesman Major Donald Maple.

However, government labs cannot handle so much new work. Thus, the Chemical Research and Development Center, the army's lead lab for work on defensive chemical systems, has contracts for testing concentrated solutions of chemical-warfare agents with 11 private firms, including SRI in Menlo Park, Calif., Battelle Memorial Institute in Columbus, Ohio, and Bendix Corp. in Baltimore.

The contracts involve relatively little work on new toxic agents. Over 90 percent

Citizens versus Chemical Warfare

of the R&D budget for chemical warfare goes to developing protective equipment that enables soldiers to fight even during a chemical attack. Efforts now focus on devising materials impervious to chemical weapons, paints that change color in the presence of toxic gases, and methods of purifying water contaminated by chemical agents. The balance of the budget goes for developing better ways to dispose of stockpiles of obsolete chemical weapons, and for experimenting with new weapons such as binary nerve gas, which consists of two components that are mixed on the way to a target.

The contracts have met a variety of criticism. Some opponents charge that the R&D budget for chemical and biological warfare (CBW) is growing faster than creative ideas on what to pursue. Others charge that there is no ethical justification for working on the most efficient means of killing ever developed by humankind. And local activists have focused on the dangers that CBW research centers might present to densely populated neighborhoods.

The Cambridge Case

In the fall of 1983, some residents of Cambridge, Mass., asked the city council to investigate reports that the firm of Arthur D. Little, Inc. (ADL) had completed a research lab in the city to conduct tests with chemical-warfare agents. The council appointed a science advisory committee (SAC) composed of scientists, professionals, and community representa-

tives to pursue the matter.

The SAC found that, although the amount of chemical agents used in ADL's new Levins Laboratory was small, their toxicity was very high. Only 400 micrograms—one-hundredth of a drop—of the most toxic, vx, kills 50 percent of adults who inhale it. The committee found that if a worst-case accident—such as an explosion or fire releasing nerve agents through broken windows—were to occur on a warm summer evening, when the adjoining disco and bowling alley were hopping and fans were watching a softball game at a nearby field, 25 to 40 persons could be killed.

"The benefits of research with these chemicals do not justify lethal risks to the general public," the SAC concluded in its report. "For this reason, the SAC believes that storage and testing of these chemical-warfare agents within the densely populated city of Cambridge in the quantities and concentration used by ADL is inappropriate."

Such concerns worry some researchers. "It is potentially dangerous for a community or a state to prohibit certain molecules," asserts William Augerson, who coordinates work at the ADL lab. "If you undertake to ban rather than regulate, you may have unintended results."

Nevertheless, similar controversies are brewing elsewhere. In Gaithersburg, Md., activist Margaret Erickson discovered that Geomet Technologies had been doing research with nerve agents only 100 yards from the local elementary school since 1983. As a result, state authorities

asked Geomet to update its analysis of potential hazards. According to Erickson, the state may issue a cease and desist order if it implies a significant risk. According to Geomet Executive Vice-President Charles Judkins, "People in positions of authority have examined us and found us to be safe and to pose no threat to public safety."

Other communities seem less concerned. "People here are a little calmer about things like that," explains Lester Hinshaw, spokesman for Battelle Memorial Institute, referring to the residents of West Jefferson, Ohio. The town contains Battelle's Hazardous Materials Laboratory and Medical Research and Evaluation Facility.

However, the controversies in Cambridge and Gaithersburg have been loud enough to bring in the Defense Department. In late May, army Acting Deputy Under Secretary Amoretta Hoeber met with members of the North Cambridge Toxic Alert, a protest group opposed to ADL's lab, as well as with officials from Cambridge and surrounding communities. Hoeber agreed to supply the group with information about private contracts for research on chemical warfare around the country, and to take part in a forum open to the entire Cambridge community.

The legal status of private and academic labs conducting research on chemical warfare is uncertain. In the spring of 1984, when the city health commissioner prohibited the use of nerve and blister agents in Cambridge, ADL promptly filed a complaint in Massachusetts Superior Court and received a temporary restraining order.

This summer, the Massachusetts Supreme Judicial

Demonstrators protest against Arthur D. Little's research on toxic nerve gases in a busy Cambridge, Mass. neighborhood. The issue has

raised a critical, and new, legal issue: Can local government regulate a private contractor working for the Department of Defense?

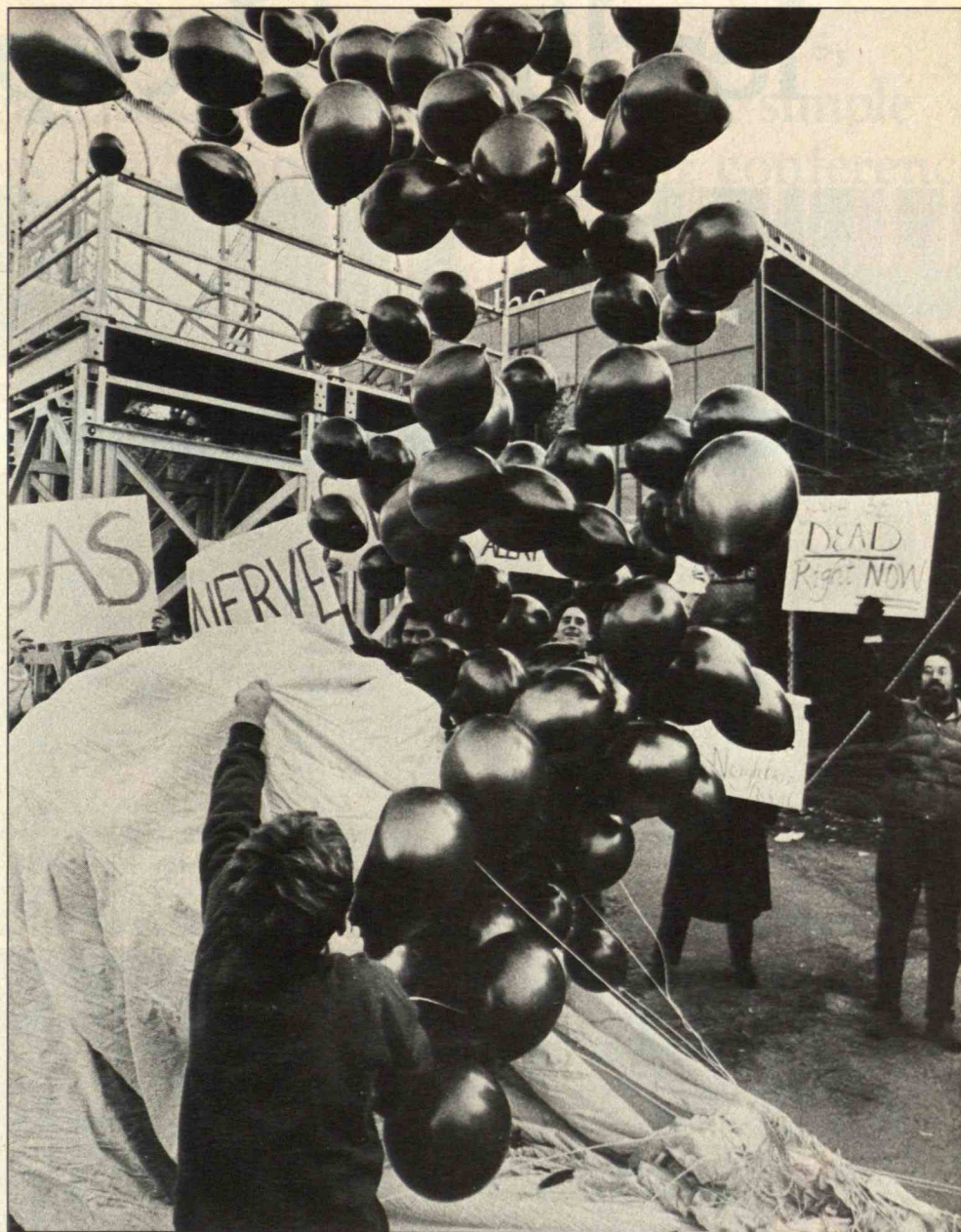
Court found the Cambridge law valid and enforceable, and denied ADL's contention that the federal government can preempt local regulation of chemical-warfare agents. ADL decided not to appeal, but the Defense Department may reopen the case, focusing specifically on a local government's power to regulate a private defense contractor. "That issue has never been presented to the Supreme Court," says Cambridge's lawyer Scott Lewis.

Is Regulation Adequate?

Critics are questioning whether chemical-warfare research is adequately regulated. No one disputes the efficacy of safety procedures within the labs, which are so detailed as to specify the length of researchers' sideburns. But "in correspondence with me," testified Rep. Michael Barnes (D-Md.), whose district includes the Geomet facility, "the army has indicated that, in effect, it has no policy with regard to the location of the testing facility. The army's interest is in insuring that the interior of the testing facility and its manner of operation meet army standards."

Barnes, with the support of Rep. Beverly Byron (D-Md.), recently offered an amendment to the Defense Department's authorization bill for fiscal year 1986. The rider requires the secretary of defense to report to the Senate and House Armed Services Committees within 90 days on the siting criteria used to evaluate the safety of labs where chemical warfare agents are used. It passed unanimously.

In Massachusetts, House Majority Leader Charles Flaherty and Rep. Thomas Gallagher have co-sponsored legislation that would em-



power the state health commissioner to regulate the storage, manufacture, and testing of chemical-warfare agents and other highly toxic chemicals. The bill would also require local hearings and allow communities to deny labs permission to work with such chemicals. The bill is seen as an important step

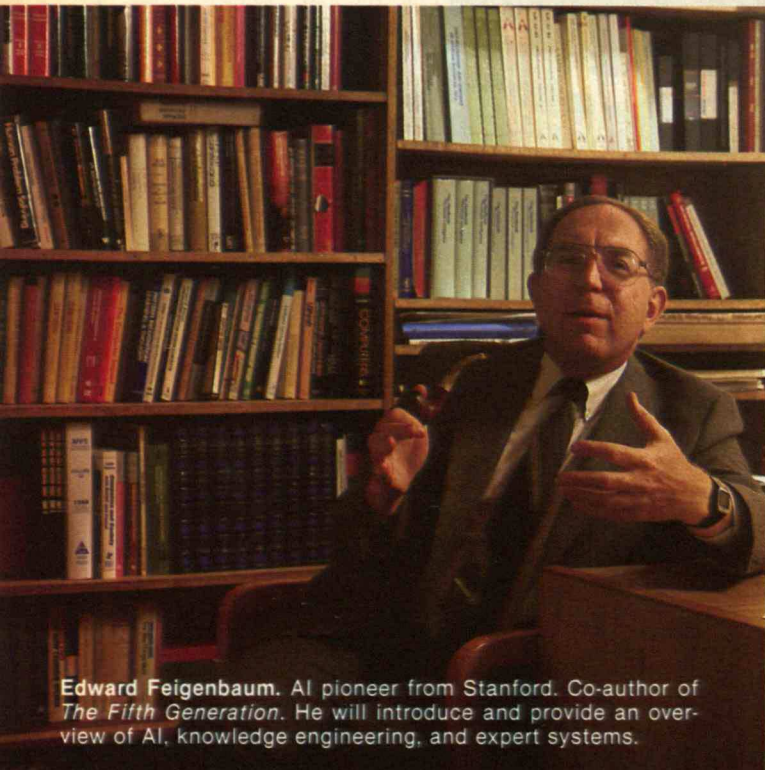
in regulating many highly toxic substances that go completely uncontrolled by the federal government.

However, some observers are concerned that the controversies in Gaithersburg and Cambridge could be the beginning of a dangerous trend with serious results for the army's research goals. Ac-

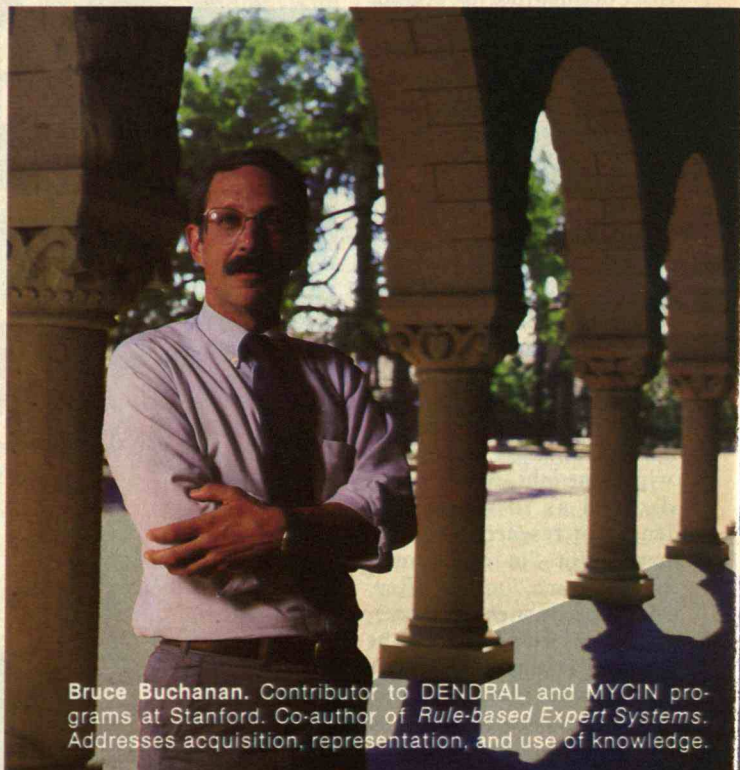
cording to one former DOD official who specialized in chemical warfare, "Denying the expertise of the academic and the private sector would hurt the program."—Daniel Grossman □

DANIEL GROSSMAN is a member of the North Cambridge Toxic Alert.

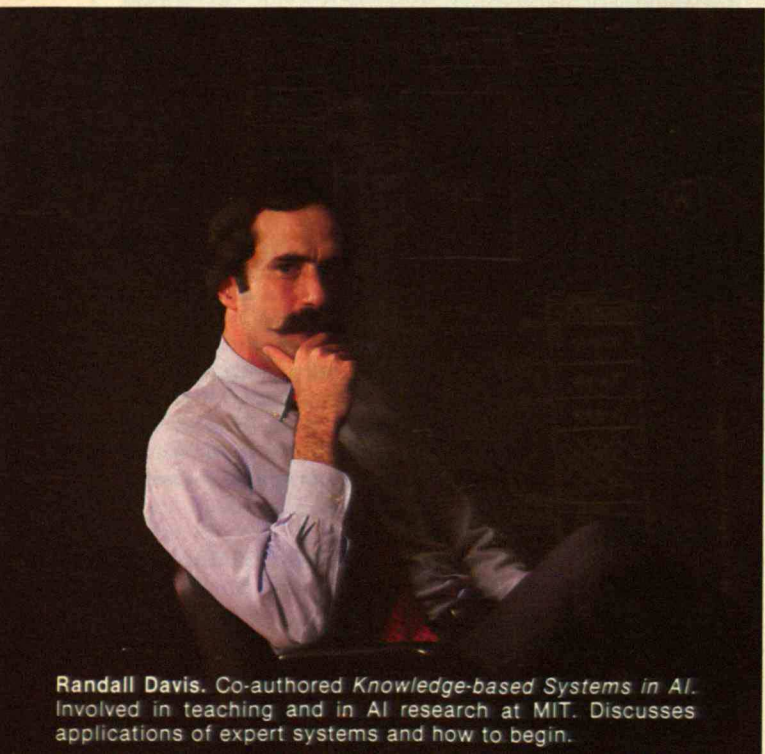
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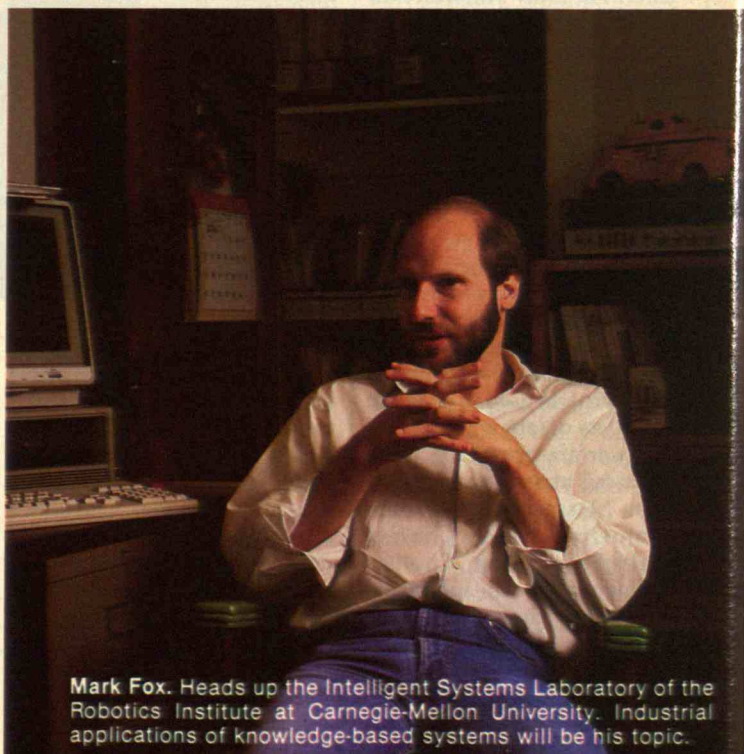
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Bruce Buchanan. Contributor to DENDRAL and MYCIN programs at Stanford. Co-author of *Rule-based Expert Systems*. Addresses acquisition, representation, and use of knowledge.



Randall Davis. Co-authored *Knowledge-based Systems in AI*. Involved in teaching and in AI research at MIT. Discusses applications of expert systems and how to begin.



Mark Fox. Heads up the Intelligent Systems Laboratory of the Robotics Institute at Carnegie-Mellon University. Industrial applications of knowledge-based systems will be his topic.

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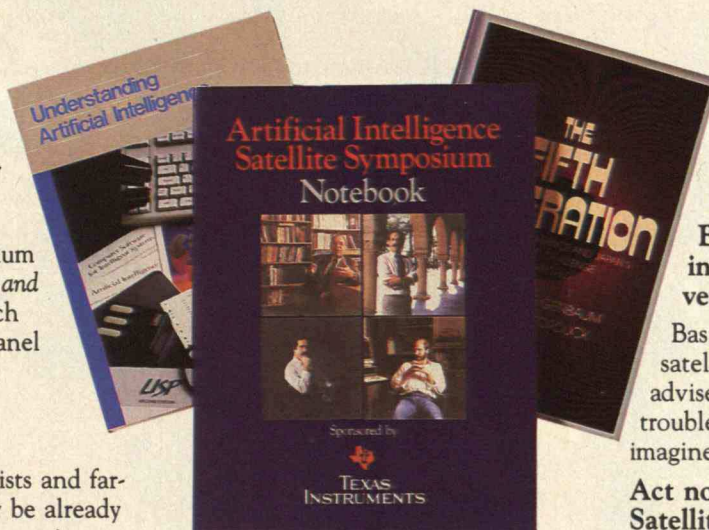
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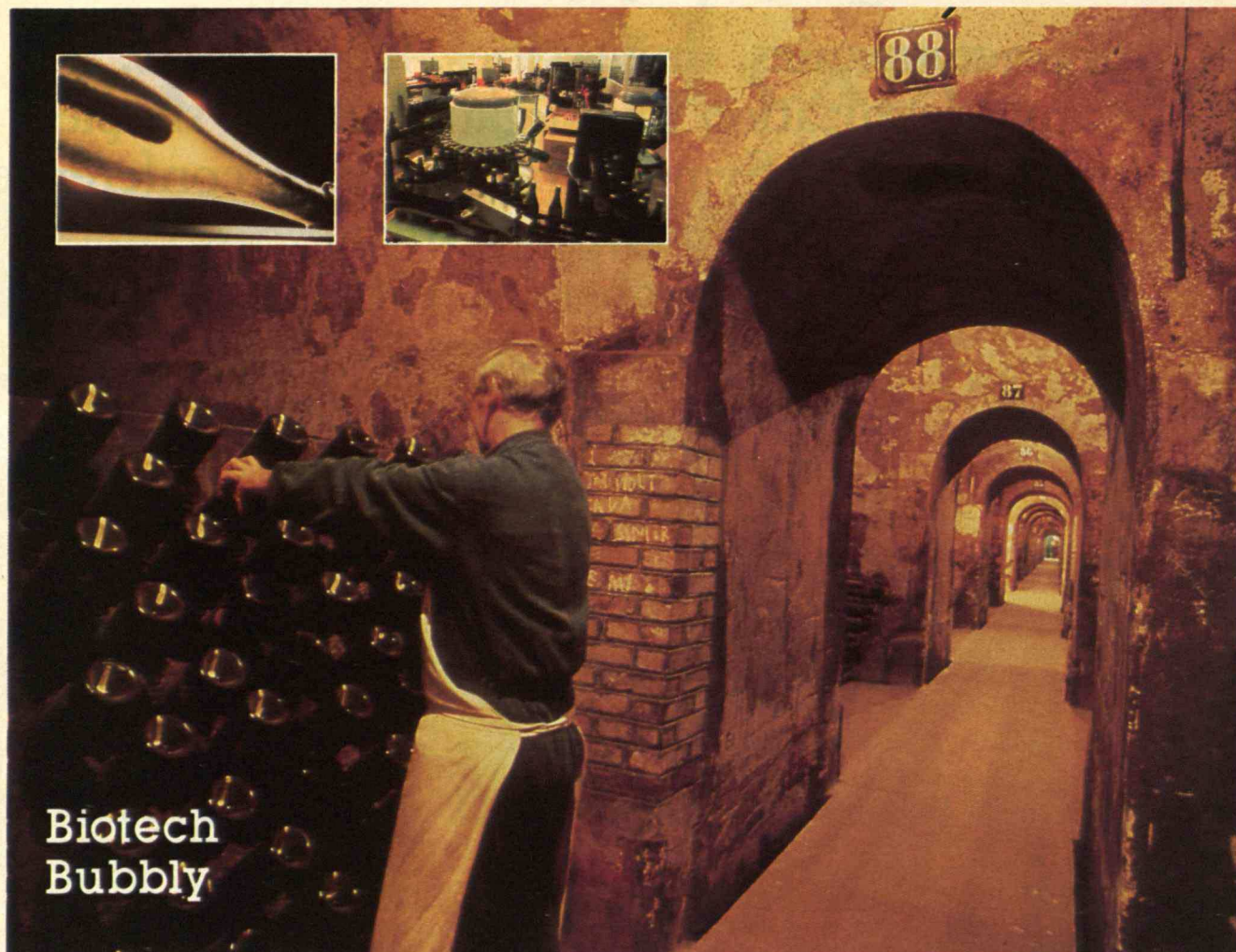
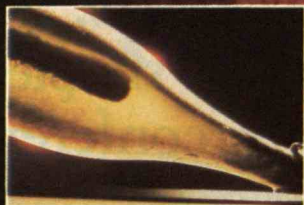
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To remove spent yeast from champagne, bottles are carefully turned and inverted (below and inset left). The complete process takes up to three

months (inset right). But use of genetically engineered yeast recently announced in France promises to reduce the timing to three days.



Biotech Bubbly

It's enough to make you choke on your Dom Perignon. The French government has announced a program to use the techniques of biotechnology to produce champagne.

A major reason for the program, according to *Nature* magazine, is the fact that champagne production, even more than other kinds of wine-making ventures, is at the mercy of changes in weather patterns. The champagne region—one of the most northerly of all wine-growing areas—produced just 80 million bottles in 1981

compared with 300 million in 1983. Viticulturists can use genetically engineered yeast to cut the time necessary to prepare champagne, thereby opening up the extra storage space needed to level out some of the fluctuations.

The new approach will affect the process known as *rémuage*—the removal of spent yeast from the champagne after the second fermentation, which gives the wine its distinctive bubbles and flavor. Normally this process requires three months of carefully turning and raising the bottles to allow yeast cells to sink to the bottom of the in-

verted bottle. An expert then rapidly opens and closes the bottles to release the unwanted yeast. The use of pellets of genetically engineered yeast, reports *Nature*, reduces the procedure to a three-day task, because the pellets sink far more rapidly than individual yeast cells.

Increasing the Capacity

The storage capacity of the champagne region will increase by 80 percent as a result. What's more, the process has no effect on the wine's bouquet, according to Moët-Hennessy, one of the major

producers of champagne.

Champagne is not alone in receiving attention from French genetic engineers. The government's new biotechnology program also includes a combination of techniques for cloning and transferring genes to create new varieties of wine grape much faster than the two to ten decades now needed to adapt a new form to a specific soil and climate, says *Nature*. That should help establish new kinds of wine grapes resistant to disease and less sensitive to spring frosts—yielding what one might term *vins extraordinaires*.—Peter Gwynne □

Tracing Humanity's Genetic Origins

Whether or not the world is ready for this, scientists have discovered a small set of genes that can serve as a genetic "passport" for different branches of humankind. These genes—passed down from generation to generation only through mothers—identify family and tribal connections as well as racial background. This finding provides a powerful new anthropological technique for examining the evolutionary differences among the peoples of Africa, Asia, and Europe. But in the hands of those bent on persecution, it could be abused.

This blueprint of human history can be found in 13 small genes—chemical code-words in DNA that contain the basic information of human heredity—tucked away inside tiny, sausage-shaped organelles known as mitochondria. These subcellular organisms make ATP (adenosine triphosphate), the basic "energy currency" used by living cells. No higher form of life can survive without them.

Locked inside the mitochondria, the 13 genes for making ATP do not participate in the normal sorting and shuffling that genes in the nucleus of the cell undergo in mating. They are passed to each new generation maternally, with no genetic contribution from the father. However, the mitochondrial genes do change gradually through chance mutations, according to Douglas Wallace, a geneticist working on

mitochondrial DNA at Emory University in Atlanta.

Wallace and his colleagues believe that members of *Homo sapiens* probably shared a common pattern of mitochondrial DNA deep in the past. But as populations split away, multiplied, and migrated to different continents, each group's DNA changed in its own distinctive way. The longer the populations were separated, the fewer the similarities left in their mitochondrial DNA.

Today, as a result, the distinctive signatures of Africa, Asia, and Europe can be seen in the mitochondrial DNA of people whose maternal ancestors came from those continents. Geneticists can also use mitochondrial DNA to distinguish among more narrow ethnic groups.

Israeli geneticists, for example, have collected evidence suggesting that Jews—despite being scattered for some 2,000 years—apparently still share some common characteristics in their mitochondrial DNA. Jews liv-

ing in Iraq, for instance, show more genetic similarities to Jews living in Poland than to the people among whom they live. The same is true of the Polish Jews, says Batsheva Bonne'-Tamir, a geneticist at Tel Aviv University's Sackler School of Medicine.

However, mitochondrial DNA from even more widely scattered and diverse Jews leads in the opposite direction: their genes more closely resemble the non-Jews among whom they live. For example, Bonne'-Tamir reports that the mitochondrial DNA of Ethiopian Jews is more similar to that of the Amhara Tribe in Ethiopia, and to a lesser extent the Billen and Tigre tribes, than to the DNA found in European and Israeli Jews.

Home of Humanity

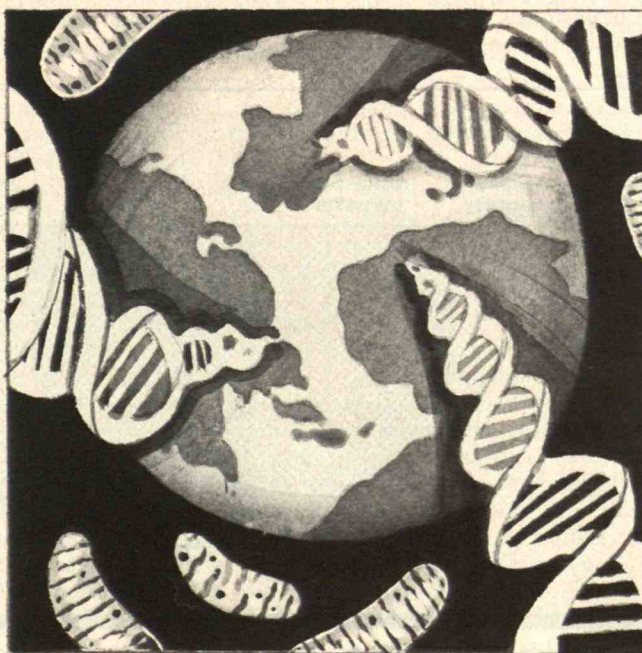
Scientists glean information about these genetic relationships by using six different restriction enzymes—proteins that break DNA only at certain locations—to slice the mitochondrial DNA into frag-

ments. Since each of the six enzymes cuts the DNA in a different way, this process creates six fragment-length patterns from any one person's mitochondrial DNA. If the genes themselves are different, then the patterns reflect these differences.

Thus, if two identical pieces of mitochondrial DNA from a mother and her child are cut with the same restriction enzymes, they should yield the same restriction-length pattern. However, if the same enzyme is used to cut the DNA from two unrelated people, the fragments come out in other lengths—with the degree of difference depending on how distantly they are related. Since different mutations occur in the history of each population, a group eventually evolves its own DNA restriction-length, or polymorphism, signature. These are what can be detected in the mitochondrial DNA.

Interestingly enough, two of the six polymorphism patterns are found in all humans. Wallace suspects that these are remnants of the original patterns—the roots of the human hereditary tree—that existed in *Homo sapiens* before the species split and groups wandered apart. And since these two common patterns seem to resemble most closely the Asian patterns that now exist, he believes that Asia was the original home of humanity. This finding should aid the work of anthropologists, who are still arguing over whether humans originated in Asia or in Africa some 50,000 to 100,000 years ago. Of course, there is evidence that pre-humans occupied sites in East Africa millions of years ago. But *Homo sapiens* is a much more recent creature.

Some people have voiced concern that such techniques



could be abused. Had this tool been available in the 1930s and 1940s, for example, might not Adolf Hitler have been tempted to use it to help identify and exterminate the Jews? Even today, might not a nation such as South Africa use it to maintain racial discrimination?

Analysis of mitochondrial DNA probably could be used for such purposes, but other means (such as studying skin color, blood groups, and birth records) are already available, and there seems little need for another.

Of far more importance is the probability that defects in the mitochondrial genes cause a few genetic diseases. Until now, inherited diseases seemed to be linked to the 80,000 genes in the cell nucleus. While a direct cause-and-effect relationship between mitochondrial genes and a human disease has yet to be proven, Wallace thinks one degenerative muscle disorder could prove to be the first known mitochondrial-based disease. If he is correct, his work will open a new area of human disease for study.—

Robert Cooke □

Bringing Inventors and Investors Together

How do inventors and small technology-based businesses find the first seed money needed to start converting innovations into products ready for the market? With great difficulty, according to Marcia L. Rorke of Mohawk Research Corp. So tough is the process of acquiring this earliest capital, asserted Rorke at the annual meeting of the American Association for the Advancement of Science, that it "would seem to justify a national concern about the adequacy of private-sector capital-support mechanisms for applied R&D."

The major problem is the huge amount of money—often hundreds of thousands of dollars—necessary to bring an invention to the stage at which it can attract funds from formal venture-capital companies. Those companies almost always refuse to invest in brainstorming that have not reached the engineering or

production prototype stage; they also look for inventions that will guarantee fast financial returns.

Rorke and her colleagues at Mohawk, a consulting firm based in Lake Forest, Ill., studied the sources of pre-venture capital. They ran three federally financed workshops that brought together a spectrum of investors, and they interviewed inventor-entrepreneurs about their sources of capital.

The group concluded that the process of funding innovations resembles an onion. At the core sits the inventor, supporting research using his or her own "sweat equity" of time, skill, and labor. To get to the visible outer skin consisting of investment companies, banks, and other professional sources of venture capital, the inventor must work through successive layers of the onion.

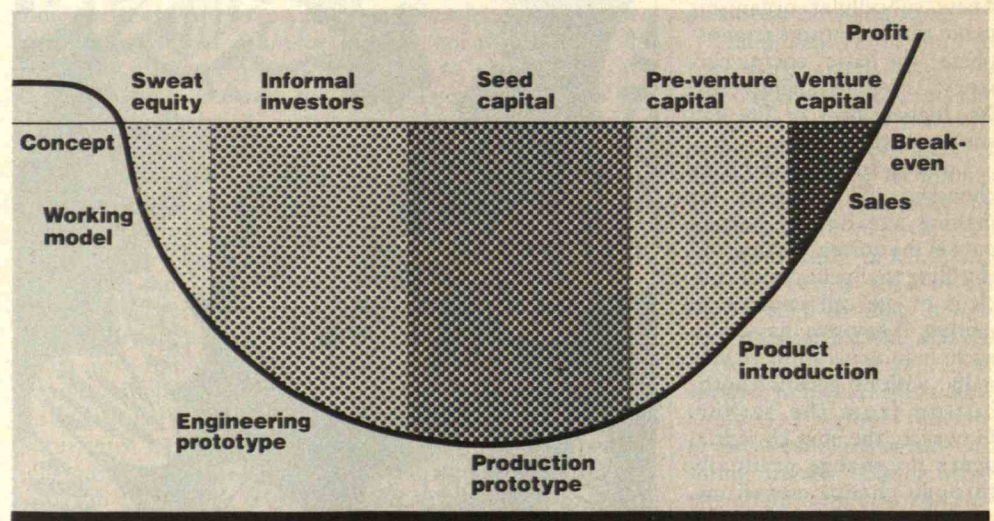
The first consists of relatives, friends, and personal acquaintances. Relatively un-

sophisticated as investors, these people want to help the inventor for personal reasons—or perhaps because they don't want "to miss out on the next Xerox."

When that money starts to run out, the inventor enters what Rorke terms "the Valley of Death"—the serious search for money from strangers or professional associates. These potential investors include actual or would-be employees; professionals such as accountants, patent attorneys, and business consultants for whom the inventor is a client; and the "old boy network" of wealthy individuals, including doctors, lawyers, and retired businesspeople.

Once the inventor has devised a working model, other sources of money may open up. These include potential suppliers and customers, who stand to gain from the inventor's success; small- and medium-scale manufacturers, who may see the opportunity to use underutilized capacity; small banks, which are more receptive to inventors than the common wisdom suggests; and even government agencies, such as the federal

Inventors seeking enough working capital to reach the stage at which their brainstorming can attract traditional venture capital must travel through a "Valley of Death." Once they have exhausted their own capital and "sweat equity," the inventors must persuade relatives, friends, professional acquaintances, and complete strangers to back the inventions—and the inventors' business abilities.



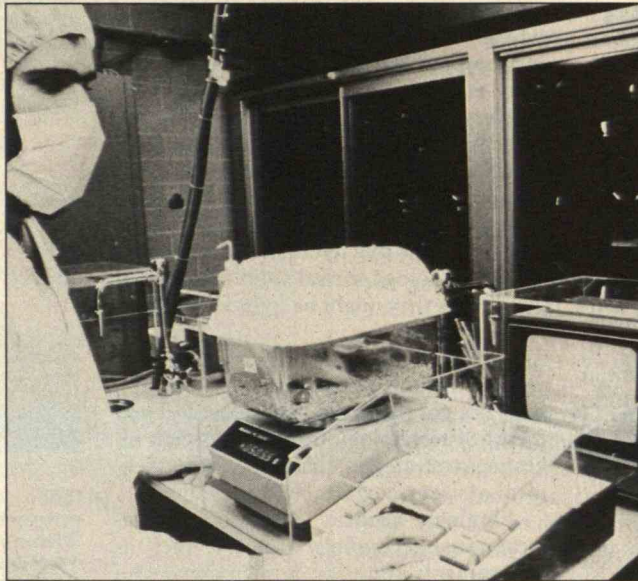
Rats exposed to pulsed microwaves at the University of Washington developed more tumors than unexposed controls.

Energy-Related Inventions Program and Small Business Innovation Research Program, and state venture-capital funds.

The business sense of the people proposing the new ventures is key to investors' decisions on whether to back them. In all but the initial funding group of family and friends, said Rorke, would-be investors seek more than "wondrous tales of the invention's technical wizardry. . . . They want the inventor to have done his business and marketing homework, as well as his technical sums."

Investors also create their own criteria for investment—such as the company's opportunities for growth—as they seek to improve their chances for large returns. Unfortunately, noted Rorke, "entrepreneurs with viable technologies and good business concepts may not meet these criteria—indeed often they are not even aware of them." All too often, commented Rorke, investors and inventors talk past each other because they approach the issues from such different perspectives.

But even if the two groups can come to a meeting of minds, Mohawk's studies indicate that the demand for venture capital exceeds the supply in the vital pre-prototype stages of applied R&D. And no relief is in sight. "If the Reagan administration's proposed flat tax on corporate profits and changes in capital gains and R&D incentives take place," Rorke declared, "these changes, together with banking deregulation, promise to increase the already great difficulties that new technology-based businesses encounter when trying to raise capital."—*Peter Gwynne* □



Microwaves and Cancer: New Evidence

The long-running debate over possible health hazards from sources of electromagnetic radiation (EMR), such as radars and television stations, has taken a new turn. Several recent studies of radar and communications workers regularly exposed to high levels of EMR have revealed evidence of possible radiation-induced cancers and brain damage.

The findings are tentative—some have not yet been published or replicated—and their implications are uncertain. Microwave specialists emphasize that the results may not hold much significance for the general public exposed only to low levels of the non-ionizing microwaves.

Nonetheless, few experts are prepared to discount the studies completely, or to say with certainty that they apply only to high exposures. "There's a body of work now pointing strongly to health

hazards," says Louis Slesin, editor of *Microwave News*, an industry newsletter that first reported many of the findings. "It's circumstantial, yes, but it's all coming together. What we don't know yet are what the danger thresholds are."

The most important of the studies, and according to Slesin the largest epidemiological study on non-ionizing radiation ever completed, examined every case of cancer reported among career Polish military personnel between 1971 and 1980. Dr. Stanislaw Szmigielski of Poland's Center for Radiobiology and Radioprotection discovered that soldiers—especially young ones—who had been exposed to high, long-term doses of microwaves and radiofrequency radiation were more than three times as likely to contract cancer as others with little or no exposure. The cancers clustered in blood-forming organs, lymphatic tissues,

and thyroids.

Several studies have previously linked EMR with cancer, but the evidence has been spotty and often unpersuasive to specialists. Szmigielski's findings, if they stand up to peer review, could mark a major change. He has already called for efforts to replicate them in another "well-defined, well-controlled" population. However, as far as U.S. researchers know, no such attempt is now planned anywhere in the world.

Another disturbing report comes from Sweden. Dr. Hans-Arne Hansson of the University of Göteborg examined about a dozen long-time military radar technicians who had begun to display symptoms of central-nervous-system damage. Radar workers have long complained of headaches, dizziness, and vision problems—so-called "microwave sickness"—but no one has ever established a definitive causal link. Hansson may have discovered a clue: he found that the workers' cerebrospinal fluid contained abnormal proteins. Such changes indicate a variety of diseases involving degeneration of the nervous system.

A recent study at Maryland's Department of Health and Mental Hygiene, of the death certificates of almost 1,000 white males killed by brain tumors, raised similar concerns. Dr. Ruey Lin and his colleagues found that a 50 percent higher than expected proportion of the men had been electrical workers: utilities' servicemen, electronic engineers, and the like. Such workers are commonly exposed to EMR from power lines and similar sources, although generally at lower intensities and frequencies than radar technicians. The elec-

Continued on page 79



Technology Transfer: Smoothing the Seas

When you buy a new Japanese-made car, the transaction is as simple as buying an American car from a U.S. automaker. It's almost as easy for you to buy stock in a Japanese company—hardly more complicated than buying shares on a U.S. stock exchange.

But it's very different if, as a U.S. entrepreneur, you want to buy or sell technology, says Richard D. Robinson, professor of international management at M.I.T. The international markets perform abysmally. There are no mechanisms to measure value, no ground rules for incentives, no ways to set fees, no market-clearing processes, no system for would-be buyers to identify all possible sellers.

The reasons are legion. Technology that works in one country may not work in another. The seller, who has a proprietary

product, may withhold some elements of which the buyer is unaware. Governments may impose restrictions, sometimes arbitrary and occasionally retroactive.

Everyone would benefit, says Robinson, if the international market for technology could be rationalized and transfer costs reduced. Robinson gave the M.I.T. Club of Singapore six suggestions late last year:

□ Set up cost-free databanks on who has what technology for sale and under what conditions they might be induced to transfer it.

□ Make new economic studies of the true value of various technologies to those who have bought them. And compare different forms of technology transfer—foreign investment strategies, licensing, and technical-assistance contracts, for example.

□ Eliminate artificial constraints on international technology transfer, such as governments' limits on foreign ownership and on transfers of profits and fees.

□ Encourage all governments to make technology work better in their economies—through training programs and incentives for foreign-trained nationals to return home, for example.

□ Provide better safeguards for both buyers and sellers, protecting each from unauthorized use of the other's proprietary rights and ensuring the enforceability of contracts.

□ Make traditional financial instruments—loans, contracts, and the like—as available for transfers of technology as they are for “hard” goods. □

Too Many Offices

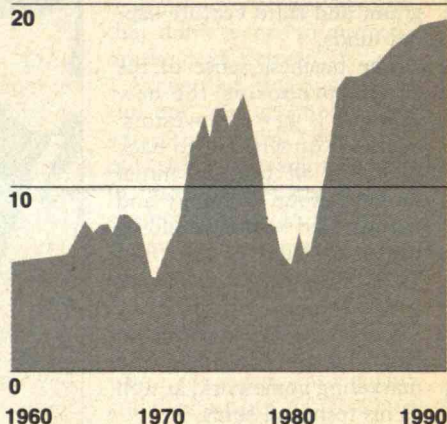
The glut of skyscraper office space that has made Houston notorious—a vacancy rate of at least 30 percent—is spreading to the rest of the nation.

A new study by the M.I.T. Center for Real Estate Development forecasts a national office vacancy rate of nearly 19 percent by 1989. There are four reasons for this surplus, say Professors William C. Wheaton and Raymond G. Torto:

□ The total number of U.S. office workers will go down as technology displaces workers and as the population ages and people retire.

□ Today's “saturated market” means that office space per worker is very generous, and even where there is new demand it can be met by “internal absorption”—more people in less space—for at least the rest of this decade.

Office vacancy rate (percent)



The cyclical boom-and-bust office real-estate market is generating an unprecedented surplus for the second half of the 1980s, says a study from the M.I.T. Center for Real Estate Management. Slower growth in the labor force is expected in the next five years, but new office construction continues apace, stimulated by favorable tax treatment and pension funds' diversification into real estate.

□ New office building has been especially vigorous in the past five years, stimulated by tax incentives, the demand for diversified investments from pension funds, and the strength of the economy.

□ The growth of high technology has put a premium on new offices with new features. However, in the final analysis, high technology means reduced demand for space—fewer files, small computers instead of big ones, word processors replacing typists, and people working at home or in lower-cost suburban areas tied by wire to their office systems.

Office building and development tend to be cyclical, say Wheaton and Torto—demand stimulates more investment than it can support, leading to surpluses when the new buildings are finally completed five years later. Then comes stagnation, slowly increasing demand leading to shortage, and another cycle of overbuilding. The stagnation in building is now overdue, say Wheaton and Torto, and they think that the surplus at the end of this decade will be large and long-lived, making the next five years a period of deep depression for office real estate. □

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The Future of Automaking

CONTINUED FROM PAGE 61

integrated with bold experiments in labor-management control of production, the result would be one of the best flexible labor-relations systems anywhere. And the national union officers would retain much of their authority: according to the agreement, they must approve exceptions to national provisions.

But success is far from assured; obstacles lie ahead. For example, the job banks raise serious questions about seniority. Should workers moved from one plant to another lose accumulated seniority, as under the present system? Should the union establish a new system of company-wide seniority? If so, who is to administer it? There is still no generally accepted way to integrate plant-level negotiations with industry-level collective bargaining. Finally, like their counterparts in the CWA, UAW shop stewards may rebel against the national union's intrusion into local work redesign and conflict resolution. Or, like their counterparts in the IAM, national UAW leaders could resent local efforts to save jobs at the expense of national contractual standards.

To be successful in coordinating flexible locals, national unions will have to accept two principles. First, they will have to give up the right to impose uniform conditions, exchanging it for the right to participate in basic business decisions. Second, to offset the divisive tendencies of local autonomy, national unions will have to find ways to represent workers broadly, perhaps by initiating joint training programs among different companies and negotiating contracts under which workers can move among firms to prevent layoffs. The nationals might also promote worker health and safety programs.

In short, national unions must steer a difficult course between the Scylla of attachment to narrow jobs and rigid rules and the Charybdis of company unionism, which would mean a failure to bargain effectively with management. Within broad limits, bargaining and political struggle will determine the results. Systematic reform of industrial relations will also require new thinking and new kinds of concessions from management. In a viable new model of industrial relations, management must give up some of its prerogatives, allowing worker and union involvement in business decisions.

HARRY C. KATZ is associate professor in the New York State School of Industrial and Labor Relations at Cornell; he held a similar post in the Sloan School of Management at M.I.T. prior to September 1. CHARLES F. SABEL is associate professor of social sciences in the M.I.T. Program in Science, Technology, and Society. A longer version of this article appears in the fall 1985 issue of Industrial Relations.

TRENDS

Continued from page 77

trical workers also tended to die younger than the nonexposed sample.

Interpreting the Results

Scientists have problems interpreting these studies. Chief among them is the variety of other health hazards the various populations could have faced. "With that kind of study, you just can't say that it's the radio-frequency radiation that's producing the effect," says Arthur W. Guy, director of the University of Washington's Bioelectrical Research Laboratory. Guy notes that a host of materials associated with electrical and electronic work—soldering fluxes, some ceramic insulators, solvents, and even older cathode-ray tubes that produce ionizing radiation—are known promoters of cancer and thus could skew epidemiological results.

It's unclear, as well, what level of EMR the populations might have received. "Let's assume, for discussion, that the Polish work is absolutely correct," says Dr. F. Kristian Storm, a California cancer specialist reviewing the voluntary EMR exposure standards set up by the American National Standards Institute. "Then I would say, what can I do about it? I have no idea what exposure those people got. That work doesn't tell us what a dangerous level of exposure is."

Unfortunately, the largest experiment on the health effects of EMR on animals, performed in a pathogen-free environment at an exposure level deemed safe by ANSI's standard, isn't reassuring either. In a five-year experiment that ended in mid-1984, Arthur Guy discovered that rats exposed to pulsed microwaves developed almost four

times as many malignant tumors as unexposed controls, chiefly in the endocrine and adrenal systems.

If reliable, these results would mean that the ANSI standard, along with many state standards based on it, is too high. Guy himself says his results are inconclusive. The distribution of different types of tumors shows statistical quirks, and the researchers suspect that stress—possibly caused by the animals' constant exposure to microwaves—might cause many of the tumors, especially the adrenal ones.

Guy would like other researchers to try to replicate this study in light of the new epidemiological data. However, no such efforts seem forthcoming. The air force supported Guy's \$4.5 million study, and has no plans at present for more such work. Moreover, one place where such a study might have been done—EPA's EMR bioeffects laboratory in Research Triangle Park, N.C.—faces extinction under the Reagan administration's FY 1986 budget.

Many people decry this lack of research, given the public's suspicion of EMR sources. Across the country citizens' groups are opposing the siting of facilities such as satellite earth stations and microwave relays. "More and more people are raising questions, and there's nothing conclusive to show," says Slesin of *Microwave News*. "Everybody could lose: the public, industry, everybody." Storm, at least, thinks the new studies, however questionable, might prove beneficial in the long term. "It's kind of like a cloud with a silver lining," he says. "It may scare some people into funding better research in this field."—David M. Kennedy □

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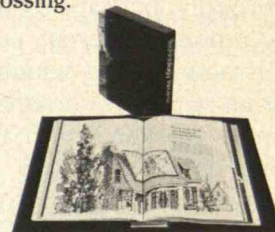
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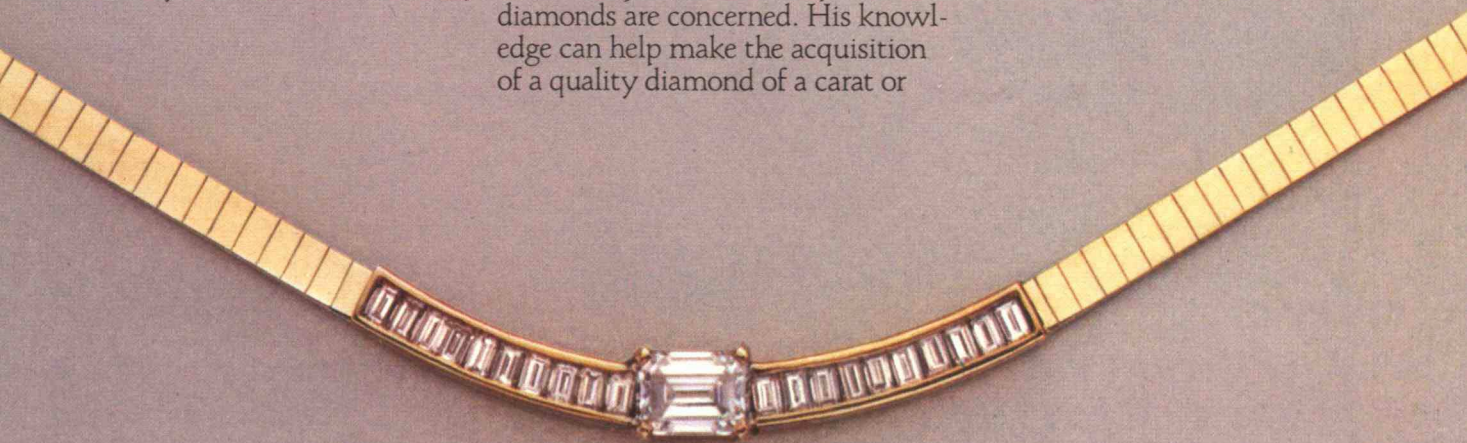
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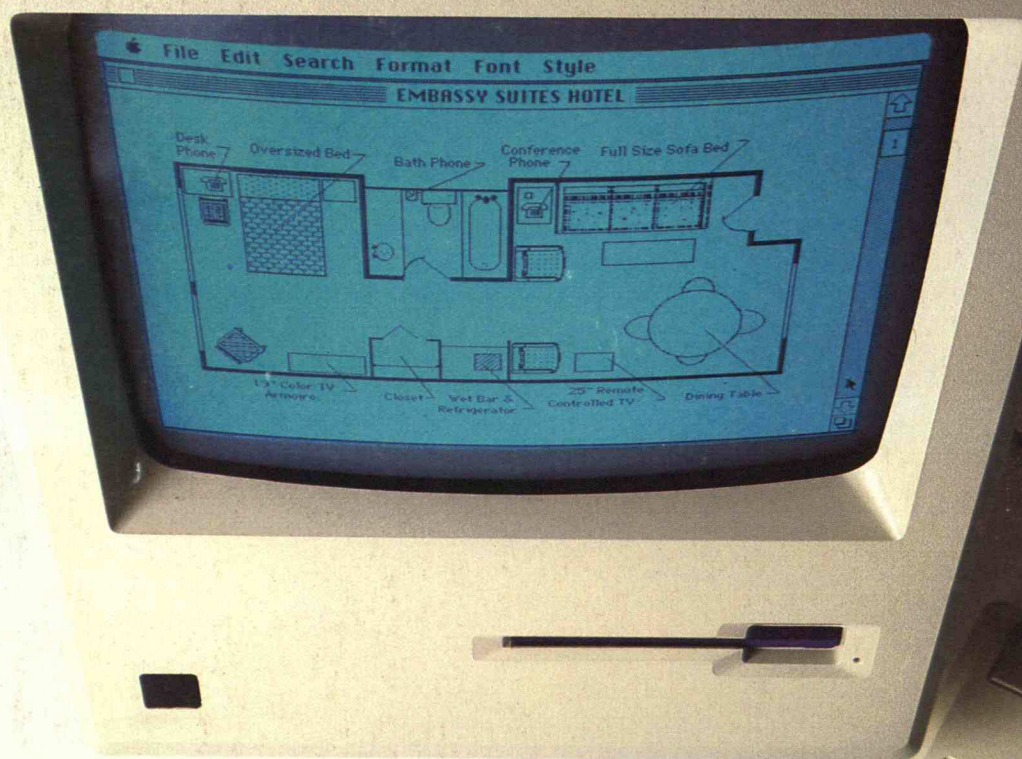
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